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THE

ONTARIO WATER RESOURCES

COMMISSION

WATER RESOURCES SURVEY

COUNTY OF WATERLOO

1966

WATER RESOURCES SURVEY 1966
WATERLOO

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A water resources survey of the county of Waterloo.

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Water Resources Survey

of the

County of Waterloo

1966

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INTRODUCTION

The Ontario Water Resources Commission carries out a broad program of water management throughout the Province of Ontario. Through this program the Commission maintains close surveillance over stream pollution, by the regular examination of streams and sources of pollution; supervises the operation of all municipal and private water-supply and pollution-control facilities; investigates the quality and availability of ground-water resources; and regulates in certain instances the development and use of water from any source of supply to ensure equitable allocation. The county water resources survey report is employed to present a summary and an analysis of the data collected through this program.

SCOPE AND INTENT

For the most part the report contains information based on data on file in the Commission offices which had been obtained up to the end of 1964. This is applicable in particular to the municipal water-supply and pollution-control facilities. In some instances, however, additional information was obtained in early 1965 where it was thought current information would present a more accurate indication of existing conditions. In this regard, 1965 information is presented on industrial wastewater disposal practices, private water-supply systems and stream water quality.

The basic intent of the report is to outline the current conditions with respect to water supply and pollution control in the county. In this regard, the efficiency and adequacy of existing municipal and private water-supply and pollution-control facilities are reviewed in order to indicate where improvements are required. Also, where such facilities are not available, conditions are reviewed to indicate areas in which water-supply or pollution-control systems are required. Surface and ground water are discussed with respect to quality, quantity, development and uses, to determine measures necessary to ensure their protection and proper development.

The ultimate objective and intent of the survey and the report is to make recommendations concerning general policies to be followed in the field of water supply and water-pollution control.

PRESENTATION

A general description of the county and the availability

and quality of the water resources are presented in chapters 2 and 3.

Chapters 4 through 18 are devoted to the individual municipalities. In these chapters the water-supply and pollution-control facilities are outlined. The present operational efficiency and adequacy are evaluated and population projections are used to determine future requirements. The surface-water quality within each municipality is related to the major sources of pollution. Conclusions based on the information presented are included at the end of each chapter. The summary and recommendations resulting from these conclusions are presented in Chapter 1.

Maps and figures are used to outline the areas of ground-water availability, municipal water and sewage areas, stream-gauging stations, sampling points on the main watercourses and the major sources of pollution.

CHAPTER 1

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CHAPTER 1

SUMMARY AND RECOMMENDATIONS

I SUMMARY

The County of Waterloo had a population of 194,034 in 1964. The county contains 15 geographical municipalities, including 3 cities, 3 towns, 4 villages and 5 townships. The economy is based mainly on the extensive manufacturing and processing industries located throughout the county. Industrial growth continues at a great rate and is supported by a sound agricultural base. The county is one of the richest agricultural areas in Canada.

Ground water is generally available for domestic use throughout the county. Where shallow dug wells are depleted due to fluctuations in the water table, it is generally possible to obtain water from greater depths. One area where ground water is difficult to obtain is in the eastern portion of the Township of Waterloo. Highly mineralized bedrock water is encountered over most of the county.

Surface water is used for industrial supplies, irrigation and fire fighting. The withdrawal of water from natural sources is regulated by the OWRC permit system to ensure the equitable allocation of the available resources. Effective conservation storage of water is required to make more efficient use of the available resources.

There are seven municipal water works systems in the county. These serve the cities of Galt, Kitchener and Waterloo, the towns of Elmira, Hespeler, and Preston and the Village of New Hamburg. All systems obtain water from wells and in addition the Town of Preston and the Village of New Hamburg augment their supplies with spring water. The water from the two spring supplies is chlorinated prior to distribution. No other treatment is provided any of the water supplies on a municipal basis. These municipal systems have been generally satisfactory from the standpoint of quantity and quality.

Several privately owned and operated water works systems serve individual subdivision developments. In all cases the water is obtained from wells. The bacteriological quality of the source water for two of these systems is questionable.

The OWRC has co-operated with many of the municipalities in the county in the construction of water pollution control

facilities, and presently operates plants in the cities of Galt, Kitchener and Waterloo, the towns of Elmira and Preston and the Village of New Hamburg. All of these systems provide satisfactory treatment with the exception of the Waterloo plant; however, plans are being developed to eliminate the inadequacies at this plant. The Town of Hespeler provides only primary treatment for its wastes, and industrial and domestic pollution have resulted in the Speed River at Hespeler.

The residents of the villages of Ayr and Wellesley and the police villages of Baden, Conestogo, Linwood, St. Clements and St. Jacobs all rely on individual waste-disposal systems. Problems are encountered with the operation of some of the systems in St. Jacobs and Baden and pollution of local watercourses results.

Although the control of pollution by industrial waste discharges is well developed, there remain a few cases where partially treated or untreated wastes are discharged directly to natural watercourses and pollution has resulted. The majority of industrial waste disposal problems may be overcome by discharge to a municipal treatment works. Some, however, will require individual treatment facilities.

The Waterloo County Health Unit actively supervises the installation of private disposal systems in the rural and suburban areas.

II RECOMMENDATIONS

County of Waterloo

1. Water conservation programs by municipalities and individuals should be encouraged to alleviate low-streamflow problems.

2. Pollution abatement programs for municipal and industrial wastes should be continued.

3. The municipalities should control the discharge of industrial wastes to sanitary sewers by the enactment and enforcement of municipal sewer-use by-laws.

4. Subdivisions should be developed only on the basis of public water pollution control systems.

City of Galt

Water Supply

1. The city should investigate the possibility of obtaining water from one of the Great Lakes in co-operation with other municipalities in the county.

2. The city's test-drilling program should be continued to acquire additional ground-water sources as an interim solution to obtaining water from one of the Great Lakes.

Pollution Control

1. The city should initiate a program to eliminate ground-water infiltration into the old sanitary sewers and to replace the combined sewers with separate sewers.

2. The discharge of untreated industrial wastes to natural watercourses should be terminated. In this regard Galt Brass Limited, the Rauscher Plating Company Limited and the Royal Metal Manufacturing Company Limited should obtain sanitary sewer connections and provide whatever pre-treatment is necessary, or provide individual waste-treatment facilities.

3. Close supervision should be provided by Allen Bradley (Canada) Limited and the Dominion Tack and Nail Company Limited to ensure that pollution does not result from their seepage pit type of industrial waste disposal.

4. All industrial waste discharges other than uncontaminated cooling water should be directed to municipal sanitary sewers.

5. The city should take the necessary action to locate the sources of domestic waste discharges to the River Street storm sewer and re-direct such discharges to a sanitary sewer.

City of Kitchener

Water Supply

1. The city should investigate the possibility of obtaining water from one of the Great Lakes in co-operation with other municipalities in the county.

2. The test-drilling program now being carried out by the city should be continued to determine additional sources of ground water as an interim measure to obtaining a source from one of the Great Lakes.

Pollution Control

1. Dominion Rubber, B.F. Goodrich Canada Limited and Kaufman Rubber Company should provide in-plant segregation of clean and contaminated wastewaters in order to eliminate the discharge of uncontaminated wastewater to the system of sanitary sewers.

2. The city should take the necessary action to locate and eliminate wastewater discharges to Schneider Creek via the Kent Avenue storm sewer and directly to the creek in its covered portion from Victoria Street to Peter Street.

3. The discharge of untreated industrial wastes to natural watercourses either directly or via storm sewers should be terminated.

City of Waterloo

Water Supply

1. The possibility of obtaining water from one of the Great Lakes in co-operation with other municipalities in the county should be investigated by the city.

2. The test-drilling program presently being carried out by the city should be continued to acquire additional ground-water sources until a supply is available from the Great Lakes.

Pollution Control

The city should investigate the sources of domestic waste discharges to the Herbert Street storm sewer and take the necessary action to eliminate these discharges.

Town of Elmira

Water Supply

A test-drilling program should be undertaken to establish suitable locations for the construction of future municipal wells.

Pollution Control

1. The town should investigate the sources of domestic waste discharges to the Arthur Street storm sewers and re-direct these discharges to a sanitary sewer.

2. Borg Fabrics Limited and Dunbar Textiles Limited should eliminate the discharge of fibrous material to the sanitary sewers.

Town of Hespeler

Water Supply

1. The possibility of obtaining water from one of the Great Lakes in co-operation with other municipalities in the county should be investigated by the town as the long-term solution to water-supply needs.

2. The town should continue a program of test drilling to determine the most favourable locations for future municipal wells for use until a Great Lakes supply is available.

Pollution Control

1. The town should undertake the immediate provision of a water pollution control plant to eliminate the domestic and industrial pollution of the Speed River.

2. The industrial waste discharges from Stamped and Enamelled Ware and Simplicity Products should be investigated to determine whether the wastes would be acceptable for treatment at a municipal water pollution control plant.

Town of Preston

Water Supply

1. The town, in co-operation with other municipalities in the county, should investigate the possibility of obtaining water from one of the Great Lakes.

2. Test drilling should be carried out to determine additional sources of ground water as an interim measure to obtaining water from one of the Great Lakes.

Pollution Control

The Kayson Plastics and Chemicals Company Limited should assess the recent process changes to determine whether increased retention-pond capacity is required to eliminate the industrial waste disposal problems.

Village of Ayr

Water Supply

The village should provide a municipal water works system.

Pollution Control

The village should provide a municipal water pollution control system.

Village of Bridgeport

Water Supply

There are no recommendations.

Pollution Control

Municipal sewer services should be extended to those areas in the village which are not now served.

Village of New Hamburg

Water Supply

There are no recommendations.

Pollution Control

1. Municipal sewer services should be extended to the area in the north end of the village which is not now served.

2. The Hahn Brass Company should provide facilities to remove suspended solids from its waste discharge.

Village of Wellesley

Water Supply

There are no recommendations.

Pollution Control

The village should take the necessary action to eliminate the discharge of domestic wastes to storm sewers and drains. If it is not possible to correct these discharges on an individual basis consideration should be given to providing a municipal water pollution control system.

Township of North Dumfries

There are no recommendations.

Township of Waterloo

Water Supply

The bacteriological quality of the water serving the Schweitzer Subdivision should be determined and chlorination facilities installed if the need is indicated.

Pollution Control

As the areas adjacent to the cities of Kitchener and Waterloo become developed, municipal water pollution control services should be provided.

Township of Wellesley

Water Supply

A sampling program should be undertaken by the operating authority to determine the bacteriological quality of the Heidelburg School water supply.

Pollution Control

J. M. Schneider Limited should exercise care in the disposal of wastes to prevent pollution of the watercourses adjacent to its property.

Township of Wilmot

Water Supply

There are no recommendations.

Pollution Control

1. A municipal water pollution control system should be provided to serve the Police Village of Baden.

2. Baden Cheese Limited should investigate and implement the requirements necessary to abate the pollution of Baden Creek caused by the wastes from the plant.

3. Tend-R-Flesh Limited should provide improved waste treatment facilities.

Township of Woolwich

Water Supply

A municipal water works system should be provided to serve the Police Village of St. Jacobs.

Pollution Control

1. A municipal water pollution control system should be provided for the Police Village of St. Jacobs.

2. The Canada Felting Company Limited, Gordon Young (Elmira) Limited, the St. Jacobs Canning Company Limited, St. Jacobs Creamery Limited and St. Jacobs Dairy should investigate and implement the requirements for providing water pollution control facilities.

CHAPTER 2

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CHAPTER 2

GEOGRAPHY AND GEOLOGY

I GEOGRAPHY

1. Topography

The topography within the County of Waterloo varies from sharply rolling uplands to gently undulating plains. The river valleys may be broad or deeply incised.

Land surface elevations vary from less than 825 feet above sea level in the valley of the Grand River to more than 1,425 feet above sea level in the Baden Hills and in the area west of St. Clements and north of Elmira.

The extensive upland area south and west of Kitchener and Waterloo comprises a distinct topographic region known as the Waterloo Hills. The region consists largely of rolling uplands with small kettle lakes and swamps. The Baden Hills are extreme examples of this topography.

Other conspicuous highland areas are the recessional moraines in the southeastern part of the county. These areas are elongated in a northeast-southwest direction. The Galt moraine southeast of Galt and the Paris moraine in the northern section of Galt are examples of these. Like the Waterloo Hills these morainic areas contain a large number of small kettle lakes and swamps.

The upland areas are surrounded by gently undulating plains. These regions are most extensive north and east of Kitchener and Waterloo and in the extreme western section of the county.

The main rivers tend to meander in broad valleys where they cross plains, but maintain a much straighter course in narrow valleys through the upland areas.

2. Drainage

General

The drainage pattern in the county is primarily controlled by features resulting from glaciation. Rivers often follow old spillways. Kame and till moraines determine, in many cases, the directions of streams. The nature of the overburden and particularly the permeability of the soils

dictate the density of the streams and streamlets and their physical and runoff characteristics.

(a) Natural Drainage

The Grand River and its tributaries provide the natural drainage for all the county.

The Grand River, which rises north of the county, meanders extensively in spillways previously formed in the till plains as it flows southerly through the county. It is joined by a number of sizeable tributaries of which the Conestogo, Nith and Speed rivers traverse parts of the county.

The Conestogo River which rises in a plain north of the county drains 13 per cent of the county and joins the Grand River at Conestogo. Its flow regime is extremely variable because of the impermeable soils in the basin. The Conestogo dam, constructed in 1959 near Glen Allan, provides artificial regulation of flows.

The Nith River rises northwest of the county and drains 37 per cent of the County of Waterloo and parts of the counties of Perth, Oxford and Brant. It originates in a clay plain, drains a large part of the Waterloo Hills, and joins the Grand River at Paris. The sandy-loam soils of the hilly region are generally well drained and help to stabilize river flows. The Nith River meanders extensively and crosses the county boundary at a number of places.

The Speed River rises to the northeast of the county where it drains the main part of the Guelph drumlin field. It drains about 9 per cent of the county, a section of the Township of Waterloo near its junction with the Grand River at Preston. The granular overburden of the area promotes natural stabilization of flows.

A number of smaller tributaries such as Canagagigue, Laurel and Hopewell creeks drain other areas of the county.

The main streams and their drainage areas within the county are shown in Table 2-1.

(b) Artificial Drainage

In general the soils in the county are well drained; however, there are sections in the townships of Wellesley, Woolwich and Wilmot where soils are imperfectly drained. Many

of these lands are artificially drained through the use of tile drainage systems and drainage ditches. A considerable number of municipal drains have been constructed in the Township of Wellesley, a moderate number in the townships of Woolwich and Wilmot, and only a few in the remaining townships of the county.

The urban municipalities have extensive storm sewer systems. These systems provide rapid runoff from large areas and contribute to erratic river flows.

TABLE 2-1

DISTRIBUTION OF DRAINAGE AREAS
WITHIN THE COUNTY OF WATERLOO BY OUTLET

	Drainage Area Square Miles	Within County Percentage of County Area
Canagagigue Creek	38	7
Conestogo River	69	13
Speed River	49	9
Nith River	190	37
Fairchild Creek	4	1
Horner Creek	2	1
Grand River exclusive of named tributaries	166	32
Grand River inclusive of named tributaries	518	100

3. Climate

The county has a humid continental type of climate which is characterized by moderate winters and warm summers. Meteorological stations in the county are located at Elmira, Galt, Kitchener, Preston and Waterloo. The frost-free period averages 139 days, from the middle of May to the beginning of October; the growing season averages 195 days. The mean daily maximum and minimum temperatures for February, the coldest month, are 22°F and 16°F, while those for July, the warmest month, are 81°F and 61°F. The mean annual precipitation is 33.5 inches including 53 inches of snow. Monthly precipitation is nearly evenly distributed throughout the year. The mean annual number of hours with bright sunshine is 1,840.

4. Land Use

The county has about 322,000 acres of assessed land, of which about 60 per cent is devoted to farming, approximately

10 per cent is covered by bush and a nearly equivalent area is waste land comprised of swamps and rugged hills. The rest of the area is occupied by urban centres.

The county is one of the highly industrialized areas in the province. Most of the industries are located in the cities and towns. The products of these industries include machinery and metal products; automobile, electrical and radio parts; brewery, distillery, confectionery, and meat products; plastics, rubber goods, chemicals, furniture, clothing and leather goods.

Farming, an important industry in the county, is devoted mainly to livestock raising and dairying. About 25 per cent of the farming area is pasture land.

5. Population

The total assessed population of the county was 194,034 in 1964, of which 85 per cent was concentrated in the urban municipalities with populations in excess of 1,000. About 88 per cent of the county's population lies in a metropolitan area which includes the cities of Galt, Kitchener and Waterloo; the towns of Hespeler and Preston; the villages of Ayr and Bridgeport; and the townships of Waterloo and North Dumfries.

Figure 2-1A shows the populations of the county, its cities and towns, and Figure 2-1B shows the populations of the county, the townships and villages since 1945.

The county has experienced an average population growth of approximately 3.5 per cent per year over the past 10 years. The cities of Kitchener and Waterloo increased their populations by 4.3 and 6.0 per cent per year respectively over the same period. The townships show little or no growth, due to annexations in some instances and to the rural nature of the townships in others.

Figure 2-1A shows also the population projections for the County of Waterloo and the Kitchener metropolitan area up to 1986 from information received from the Department of Economics and Development. Two curves are shown for the county based on two assumptions, A and B, which relate to the entire province. The conditions for assumption A are: net immigration - 10,000 per year, and net inter-county migration - 2,000 per year. Those for assumption B are: net immigration - 30,000 per year and net inter-county migration - 6,000 per year. In addition the figure shows the population projections for the cities of Kitchener and Waterloo based upon published

population estimates for 1969. Further projections for these cities and the projections of other urban municipalities are based on an annual population growth of 3.25 per cent.

II GEOLOGY

1. Bedrock

Bedrock formations within the county belong to the Silurian and Devonian systems of the Palaeozoic era. Brown to buff dolomite, grey, greenish and reddish shales, grey limestones, and varying amounts of gypsum of the Salina formation underly the overburden throughout the central section. The Salina formation is underlain by the buff to brown dolomite of the Guelph formation in the central section. At the eastern edge of the county the Salina formation was removed by erosion and the Guelph formation underlies the overburden. In the western part of the county buff and grey dolomite of the Bass Island formation of Silurian age overlies the Salina formation. At the extreme western edge of the county the cherty limestone of the Bois Blanc formation of Devonian age is found immediately beneath the overburden. Figure 2-2 shows the boundaries of the different bedrock formations.

The bedrock surface slopes generally southward with an indication that a preglacial bedrock depression trending southeasterly starts in the vicinity of the Village of Wellesley and extends past the Village of Ayr where it turns in a southerly direction. The difference between the lowest bedrock elevation south of Ayr and the highest one in the northern-most part of the county is over 500 feet. The bedrock surface shows relatively sharp relief in the Township of Wilmot beneath the Waterloo Hills. The relief of the bedrock surface throughout the remainder of the county is generally gentle.

2. Overburden

The bedrock is generally overlain with a mantle of unconsolidated deposits. The overburden is missing locally in the eastern-most part of the county and in places in the valleys of the Grand and Speed rivers and has a thickness of more than 460 feet in the mid-western section of the county in the Waterloo Hills.

The overburden is composed largely of glacial and glaciofluvial deposits which were laid down during Pleistocene time, when the area was covered by a continental ice sheet. The topography of the county is governed largely by these deposits. The main physiographic features are shown on Figure 2-3.

The overburden deposits are complex and may change greatly over short distances; however, when examined regionally they may be divided into characteristic groups according to their physical characteristics and method of deposition.

During the latter part of Pleistocene time the area occupied by the county lay between two ice lobes, one advancing from the Lake Ontario basin and the other from the Lake Huron basin. As these ice lobes advanced they deposited a ground moraine composed of materials which had been picked up and transported by the ice. This material is referred to as till and normally consists of poorly sorted sediments of which clay or silt is dominant. Deposits of sand and gravel found interbedded locally with the till were laid down by melt-water streams flowing from the ice sheet. Deposits of ground moraine are most extensive in the extreme western and northern parts of the county. They form gently rolling lowland areas.

The Waterloo Hills are composed largely of stratified sand and gravel, and sandy till. Some of this material may have been deposited during an early ice advance but much of it was deposited in water at or near the ice front as the ice lobes receded. This type of deposit is called a kame. Outwash deposits of sand and gravel which may be associated with kames were laid down by flowing water farther from the ice front. The materials were carried to the area of deposition by subglacial and englacial streams or simply collapsed from the ice front into a receiving body of water.

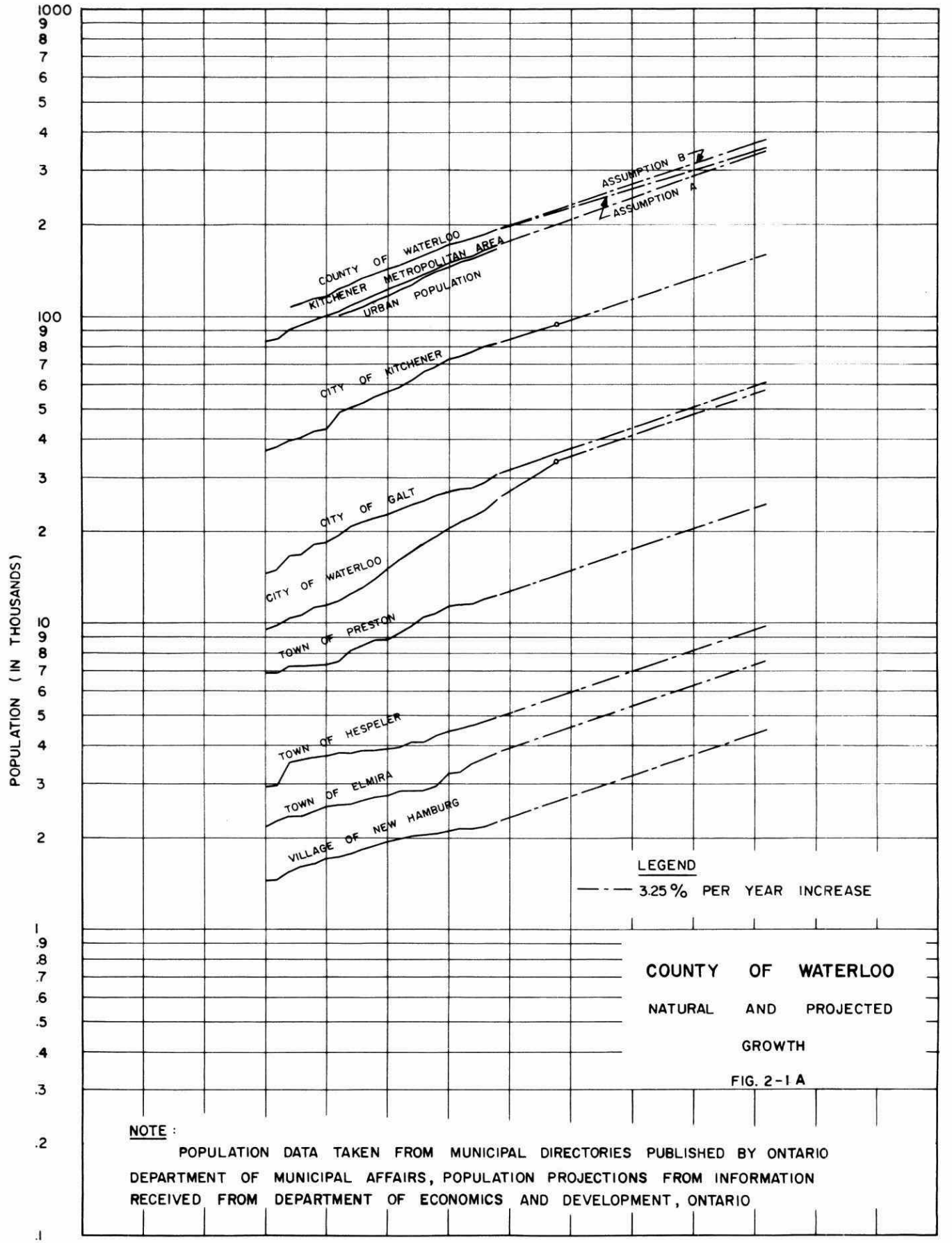
Where the subglacial melt-water streams were confined in tunnels, ridges of stratified sand and fine-to-coarse gravel were formed. These ridges are known as eskers. One of the best examples of this can be seen just east of West Montrose. Eskers are usually associated with kame deposits, since both originated during rapid melting of ice.

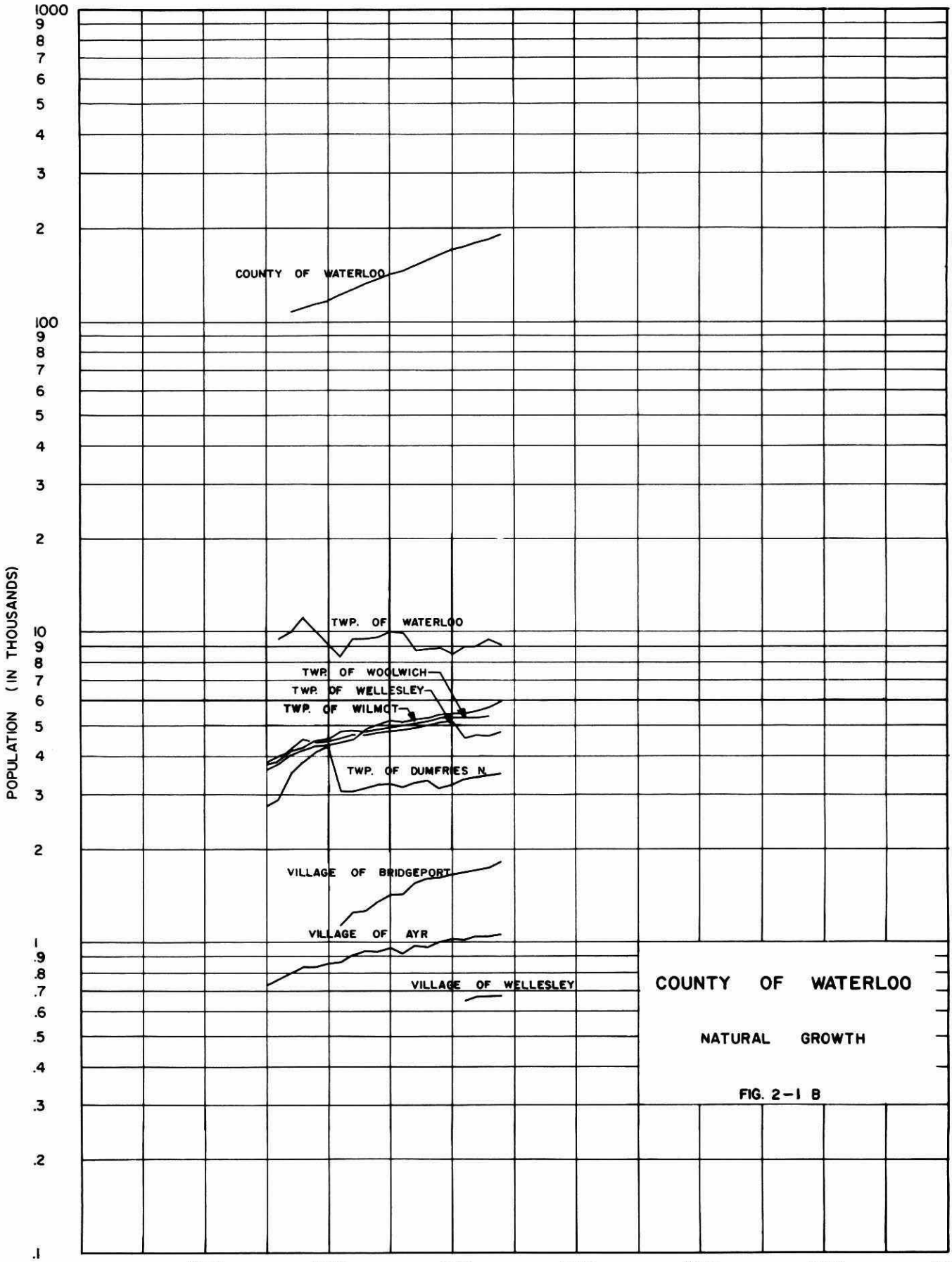
Depressions, or kettles, were formed during the melting of stranded ice-blocks, which were partly or completely buried by outwash deposits. This resulted in an irregular and hummocky topography with numerous small lakes and swamps. It is called "kame and kettle" topography and is common in parts of the Township of North Dumfries.

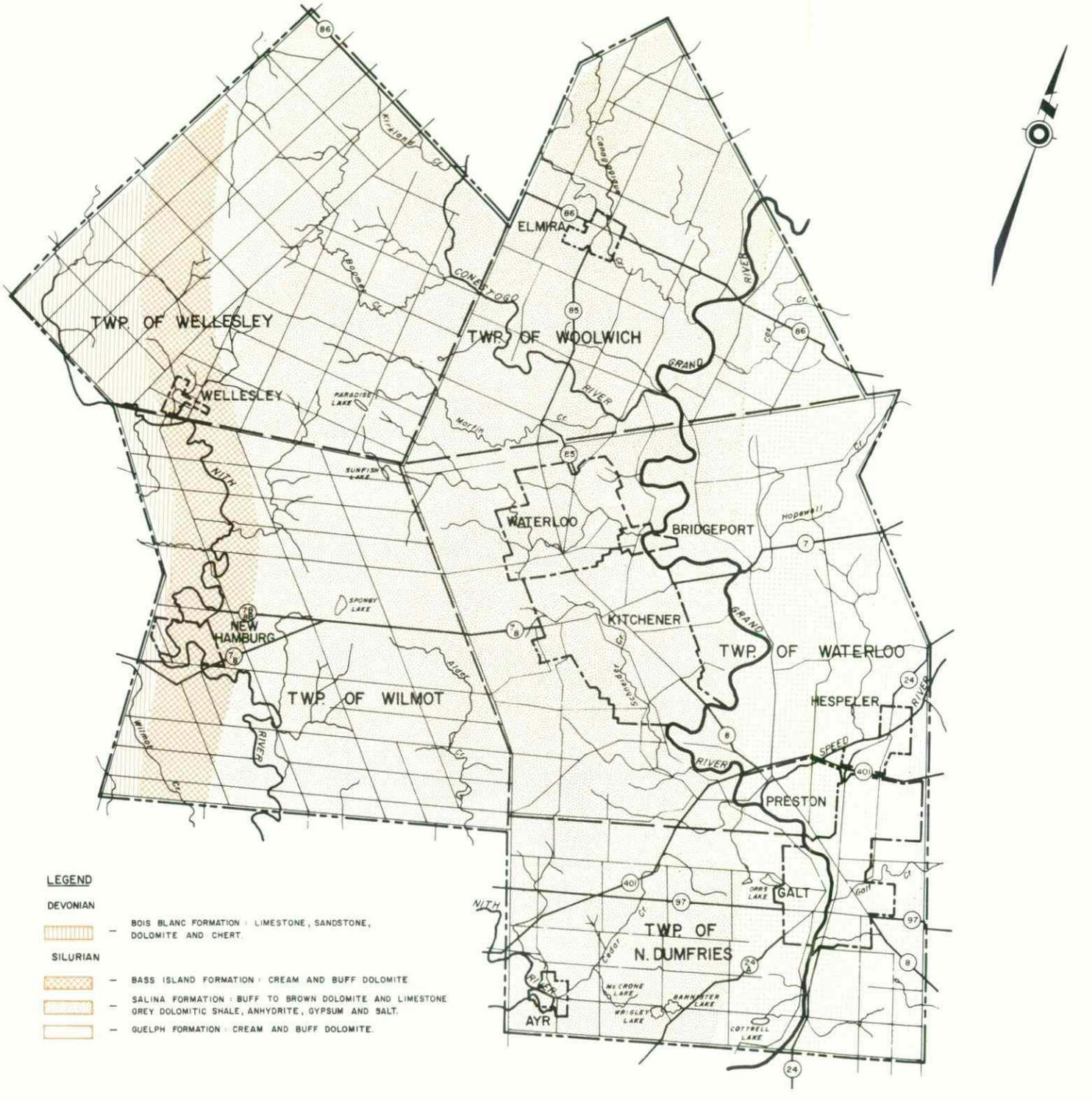
A number of readvances occurred during the recession of the ice sheets. The extent of the readvances are marked by northeast-southwest trending moraines, which are composed of till and are locally flanked by kames. Examples of these are the Paris and Galt moraines in the vicinity of Galt. In

the area northeast of Kitchener, oval hills, called drumlins, mark the trend of the glacier's advance.

Spillway valleys which were eroded by glacial melt-water have dictated to a large extent the present drainage pattern of the area. Good examples of such features are the valley of the Speed River which occupies a spillway in front of the Paris moraine and the valley of the Grand River which occupies a spillway channel which cuts through the Paris moraine at Galt. The Nith River follows another important spillway channel. Deposits of sand and gravel are present in many of the spillways. Some of these are in the form of gravel terraces along the flanks of the spillways.


POPULATION (IN THOUSANDS)
1000
100
10
1
.9
.8
.7
.6
.5
.4
.3
.2
.1
1940
1950
1960
1970
1980
1990
2000
YEARS
COUNTY OF WATERLOO
KITCHENER METROPOLITAN AREA
URBAN POPULATION
ASSUMPTION B
ASSUMPTION A
CITY OF KITCHENER
CITY OF GALT
CITY OF WATERLOO
TOWN OF PRESTON
TOWN OF HESPELER
TOWN OF ELMIRA
VILLAGE OF NEW HAMBURG
LEGEND
3.25% PER YEAR INCREASE
COUNTY OF WATERLOO
NATURAL AND PROJECTED GROWTH
FIG. 2-1 A
NOTE :
POPULATION DATA TAKEN FROM MUNICIPAL DIRECTORIES PUBLISHED BY ONTARIO DEPARTMENT OF MUNICIPAL AFFAIRS, POPULATION PROJECTIONS FROM INFORMATION RECEIVED FROM DEPARTMENT OF ECONOMICS AND DEVELOPMENT, ONTARIO


POPULATION (IN THOUSANDS)
1000
9
8
7
6
5
4
3
2
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
.9
.8
.7
.6
.5
.4
.3
.2
.1
COUNTY OF WATERLOO
TWP. OF WATERLOO
TWP. OF WOOLWICH
TWP. OF WELLESLEY
TWP. OF WILMOT
TWP. OF DUMFRIES N.
VILLAGE OF BRIDGEPORT
VILLAGE OF AYR
VILLAGE OF WELLESLEY
1940
1950
1960
1970
1980
1990
2000
YEARS
COUNTY OF WATERLOO
NATURAL GROWTH
FIG. 2-1 B



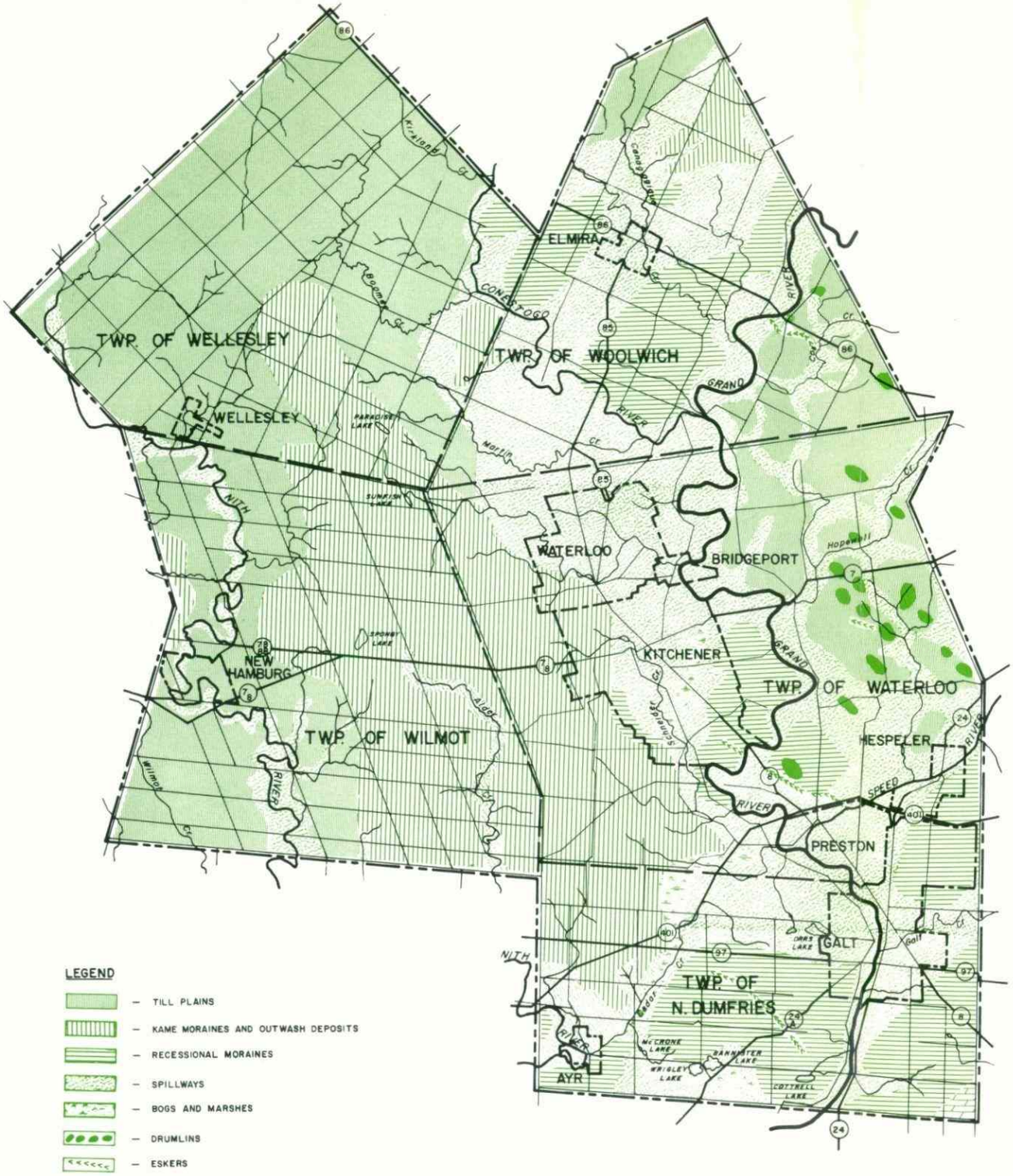
NOTE

BEDROCK GEOLOGY AFTER B.V. SANFORD GEOLOGICAL MAP OF SOUTHWESTERN ONTARIO 1958

ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO
BEDROCK GEOLOGY
FIGURE 2-2

SCALE : 1 0 1 2 3 MILES	
DRAWN BY : L.L.B.	DATE : JAN., 1966
CHECKED BY : A.Y.	DRAWING No : 66-5



NOTE

PHYSIOGRAPHY OF THE AREA AFTER L.J. CHAPMAN AND D.F. PUTNAM
PHYSIOGRAPHY OF SOUTHERN ONTARIO 1951 AND P.F. KARROW
PLEISTOCENE GEOLOGY OF THE GALT AREA 1962

ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO
PHYSIOGRAPHIC REGIONS
FIGURE 2-3

SCALE: 0 1 2 3 MILES	
DRAWN BY: L.L.B.	DATE: JAN., 1966
CHECKED BY: A.Y.	DRAWING No: 66-5

CHAPTER 3

WATER RESOURCES

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CHAPTER 3

WATER RESOURCES

I INTRODUCTION

The ground and surface waters have played an important role in the county's development. Wells and springs are used to supply ground water for municipal, industrial, commercial and private purposes. Streams are used as sources for agricultural, industrial, and municipal fire fighting requirements; and as outlets for natural and storm drains and for municipal and industrial waste-disposal systems. Formerly many of the streams were used to power mills and factories but this use has nearly disappeared.

In this chapter, quantitative and qualitative aspects of the water resources are reviewed in relation to existing and future needs. The main sources of water supply for drilled wells throughout the county are shown in Figure 3-1. The county is shown in relation to the Grand River watershed in Figure 3-3, which also shows the drainage pattern and divides and existing and proposed dams and reservoirs in the watershed.

One conservation authority and one conservation commission function within the county. They are the Grand Valley Conservation Authority and the Grand River Conservation Commission. Reference is made to their flood-control and water-management programs.

II WATER MANAGEMENT LEGISLATION

The province has recognized the importance of water and the problems that result from multiple and unlimited use of water and the need for management and control of water resources. Brief mention is made below of some of the statutes and programs pertinent to water-resources management.

In 1961 a permit system to provide for a sharing of the available supply of water and the alleviating of serious water-use interference problems was introduced under Section 28(a) of The Ontario Water Resources Commission Act. Most new takings of water in excess of 10,000 gallons in a day require authorization by permit from the Commission.

In 1963 The Agricultural Rehabilitation Development Act (Ontario) was enacted. It provides for cost-sharing agreements between the provincial government and the federal government on projects of development and conservation for agricultural purposes. These include works and research related to conservation of soil and water.

Under The Conservation Authorities Act, conservation authorities may be established to carry out conservation programs related to flood control, streamflow, land use, forestry, wildlife, and recreation.

In 1964 the Minister of the Department of Energy and Resources Management announced a 3-year program designed to encourage construction of farm ponds and reservoirs. Subsidies amounting to 50 per cent of the construction costs, up to a maximum of 500 dollars, may be paid to farmers for ponds approved by the Department of Agriculture. The Department of Energy and Resources Management increased its grants to conservation authorities from 50 to 75 per cent of construction costs. In some cases the Government of Canada may share the cost.

Sections 26 and 27 of The Ontario Water Resources Commission Act are designed to control pollution of the province's water resources. Section 27 of the Act makes it an offence for any municipality or person to discharge or deposit material that may impair the quality of ground or surface water.

Section 28(b) of the same Act was introduced to regulate the use of substances for controlling or affecting plant or animal life in water. Additions of such substances to ground or surface waters, with few exceptions require authorization by permit from the Commission.

Under Section 50 the Commission has the authority to require all industrial and commercial enterprises to provide facilities for the proper collection, transmission, treatment or disposal of wastes. A penalty is provided for failure to comply to a direction under this section.

III GROUND WATER

1. Occurrence

The distinction between ground and surface water is simply related to their relative and temporary positions with respect to the land surface. Both are part of a circulating system of water, called the hydrologic cycle. A portion of the water that falls upon the land surface in the form of rain, snow, sleet, or hail infiltrates through an unsaturated zone in the ground, known as the zone of aeration, and into a zone of saturation below. In the zone of saturation, water fills all openings in the earth's formations. The upper surface of this zone is referred to as the water table. The depth to the water table varies from area to area depending on the relative elevation of the land surface, the permeability of the earth's materials and the amount of precipitation. The water table fluctuates annually and is generally highest in the spring and lowest in the fall. Very little precipitation infiltrates

past the zone of aeration during the summer. In fact, during this period, a large amount of ground water is normally lost by evaporation and transpiration.

Ground water moves constantly under the influence of gravity. The rate of movement is controlled largely by the permeability of the geologic formations through which the water passes. Formations consisting of fine-grained materials, such as clay and silt, generally contain more pore space per unit volume and thus more water than formations of coarser grained materials, such as sand and gravel; however, water will not move through the finer materials as readily as it will through the coarser. Bedrock formations generally do not contain large volumes of water per unit volume, but fractures and joint planes in limestone and dolomite are often able to transmit appreciable quantities of water. Shale usually contains fewer open spaces and generally does not yield much water. All formations that permit the movement of substantial quantities of water through them are called aquifers.

Ground water is the source of much of the water supply in the county. There are good aquifers both in the overburden and bedrock. Figure 3-1 shows the areas where the overburden or the bedrock constitutes the main aquifer and areas where supplies of water are obtained from both the overburden and the bedrock.

2. Availability

The availability of ground water depends largely on the ability of the water-bearing formations to transmit water to wells. Overburden deposits containing coarse, sorted materials, such as sand and gravel, are generally the most permeable and thus constitute the most important aquifers for the development of high-capacity wells. Silt and clay yield water very slowly. The bedrock yields various quantities of water, depending on the rock type and local permeability. Usually, the first few tens of feet of rock yield the most water. Water quality is likely to deteriorate with depth in the bedrock in most places.

The main area where ground water is difficult to obtain is in the vicinity of the east boundary of the Township of Waterloo. In some other areas, low static levels and thick overburden necessitate the construction of deep wells to obtain satisfactory supplies.

Overburden Aquifers

Because of the heterogeneous nature of the overburden it

is only possible to review the aquifers present in it in general terms. Figure 2-3 shows the physiographic features which are present in the county. The hydrologic characteristics associated with these features are reviewed below.

Till Plains

The till plains are composed largely of clay, silt and stones and have poor hydrologic characteristics. Interbedded sand and gravel deposits occur locally, and these may supply sufficient water for domestic and farm needs.

Kames

Deposits of sand and gravel in the form of kames occupy extensive areas in the county and when saturated with water constitute one of the most important groups of aquifers. Included in this category are the Waterloo Hills and local kame deposits along the flanks of the recessional moraines.

Recessional Moraines

Recessional moraines are a complex of largely unsorted clay, silt, sand and gravel. Some wells may obtain water from coarse-grained parts of the deposits, but the yield of such wells generally is sufficient only for domestic needs.

Outwash and Spillway Deposits

Outwash and spillway deposits are extensive in the lowland areas to the east of the Waterloo Hills. Spillway deposits are present locally in the valleys of the major rivers. Where sufficiently coarse-grained and thick, these deposits are good sources of ground water. They may support high-capacity wells.

One of the best water-yielding areas in the overburden is the kame area west and southwest of the City of Kitchener. Three aquifers, or groups of aquifers, can be distinguished in that region: upper, middle and lower. The division is based on the location of the aquifer within the sequence of overburden materials but does not necessarily imply continuity or hydraulic connection within the group.

The upper aquifer group is located in the most recent sand and gravel outwash deposits, some kame deposits and the upper, thin sand and gravel deposits which cover the area. This aquifer group feeds dug or shallow wells. In recent years the water level has gone down and many dug wells have become dry.

The middle aquifer group contains the main aquifers in the area. The aquifers are composed mainly of sand and gravel and are generally covered by till. Most of the City of Kitchener municipal wells are supplied by these aquifers.

The lower aquifer is composed of sand or sand and gravel. It is separated in places by till from the middle aquifers. There are no municipal wells located in it, although it is a potential source of ground water.

Other good water-producing areas are associated with spillway deposits around the Town of Elmira and south of the City of Kitchener.

There are some areas where conditions are not favourable for the construction of drilled, overburden wells. One such area is the southwest corner of the Township of Wilmot where there are few, deep, overburden wells.

Bedrock Aquifers

Satisfactory bedrock wells are obtained in most sections of the county. The better yields seem to be from wells in or near the valley of the Grand River. Numerous flowing wells are located in that area. The characteristics of the bedrock aquifers are related to the formations in which they occur.

Guelph Formation

The Guelph formation, which forms the bedrock surface in the eastern section of the county, is one of the best bedrock aquifers in the province. The aquifer is tapped by a number of high-capacity wells which supply water to the City of Galt and the towns of Hespeler and Preston. The Lockport formation, which occurs beneath the Guelph formation, and may be hydraulically connected with it, is also an excellent aquifer in many places.

Salina Formation

Some wells in the Salina formation obtain abundant supplies of water; however, the water may be excessively hard and contain hydrogen sulphide, particularly where obtained from the lower part of the formation.

Bass Island and Bois Blanc Formations

Adequate supplies of water for domestic and farm needs

are generally obtained from the Bass Island and Bois Blanc formations. It is possible that high-capacity wells could be constructed in these formations, particularly in the extreme west where the formations are thickest.

Recharge

The average annual precipitation of the county is 33.5 inches. Only a portion of this, possibly less than 10 per cent, reaches the water table to recharge ground-water aquifers. The rate of ground-water recharge is estimated to be some 100,000 gpd per square mile in much of this area, and is probably somewhat higher in certain of the sandy areas. The recharge is greatest during the months of October to April when the effects of evapo-transpiration are low, and is usually negligible during the summer months.

The amount of ground water that would be available in the county based on the estimated rate of recharge of 100,000 gpd per square mile would be approximately 50 mgd. In practice it is unlikely that all the available water could be developed. The present ground-water consumption in the county is approximately 24 mgd, about half the estimated ground water available.

The local availability of ground water is discussed under the various municipalities in the county.

3. Quality

Figure 3-2 shows the locations of sampled municipal and private wells, those wells which were reported to have high sulphur or mineral content, and flowing wells.

Table 3-1 lists the results of the chemical analyses of the water samples collected from the overburden and the various bedrock aquifers and provides a general indication of ground-water quality in the county. The results of chemical analyses from the municipal wells are listed under each municipality.

From Figure 3-2 and Table 3-1 of the chemical analyses the general relations set forth below can be determined.

The overburden has ground water of very variable quality. The water is generally very hard, and in the mid-eastern part of the county it may be extremely hard because of a very high sulphate content. The hardness ranges from 128 to 1650 ppm. The high sulphate content in the overburden is probably derived from the underlying Salina formation. The iron content is

usually higher than the recommended upper limit of 0.3 ppm for drinking water. Chloride values vary considerably but even the highest value obtained, 200 ppm, is lower than the recommended upper limit of 250 ppm. The fluoride content is usually low throughout the county; values range from 0 to 0.4 ppm.

The Guelph formation yields very hard water, but hardness values rarely exceed 500 ppm. The iron content ranges from 0.05 to 4.35 ppm with values generally higher than 0.3 ppm. Fluoride contents somewhat higher than in the overburden are found in the Guelph formation.

The Salina formation yields water with the poorest chemical quality in the county. Water from the base of the formation just west of the Grand River has extremely high hardness values caused by the high sulphate content. The sulphate content is due likely to the dissolving of gypsum as the water moves through the gypsum-bearing Salina shales and dolomites. Iron content ranges from 0.02 to 37.6 ppm. Wells terminated in the Salina formation in the mid-western part of the county yield better quality, but still quite-hard, water.

Good-quality water is obtained from the Bass Island and Bois Blanc formations. Hardness values range from 144 to 370 ppm, usually the lowest in the county. Other chemical qualities are also fairly consistent.

Water from rock wells sometimes contains hydrogen sulphide which may make the water unpalatable.

The ranges in the chemical quality of samples from municipal and private wells terminated in the different aquifers are summarized in Table 3-2.

4. Uses

It is estimated that in 1964 the consumption of ground water in the county averaged nearly 24 mgd. Ground water is the main source of supply throughout the county. Six large municipalities and nearly 500 industries are located in the county. The greatest use of ground water is in the metropolitan areas.

(a) Municipal

The following municipalities have municipal water systems which utilize ground water: the cities of Galt, Kitchener and

Waterloo; the towns of Preston, Hespeler and Elmira; and the Village of New Hamburg. In 1964 the municipal water systems used an average of 17.4 mgd. About 60 per cent of this was used for industrial purposes.

(b) Industrial

In addition to approximately 10.4 mgd obtained from municipal sources, industries use approximately 3.5 mgd from private wells. The total industrial consumption of ground water is approximately 13.9 mgd, about 58 per cent of the ground water used in the county.

(c) Private

Smaller population centres generally have some small, private water works systems in addition to individual private wells. Motels, farms, and some subdivisions have their own wells. An estimated 3 mgd of ground water is used by these consumers.

IV SURFACE WATER

1. Streamflow

Continuous records of streamflow for the Grand River system date from July 1913. Since that date an extensive network of streamflow gauging stations has been established in the basin on both major and minor streams. Stations are operated by either the Department of Northern Affairs and National Resources or the Grand River Conservation Commission. Table 3-3 lists the streamflow gauging stations whose records are most significant in an assessment of the surface water resources of the county and provides a summary of their physical and discharge data. The stations listed lie either within or immediately above the county. All except one are equipped with automatic recorders. Table 3-4 provides a summary of an analysis of the annual streamflow data showing the range of flows for each of the conditions given in the column headings over the stated period of record. For example, under the heading "Maximum Day" two values appear for each time interval shown in the first column, a maximum value and a minimum value. The maximum value gives the largest annual maximum-day flow and the minimum value gives the smallest annual maximum-day flow over the period of record. The minimum flow conditions are of paramount importance with regard to water supply and waste dilution, as they define the surface-water supply of the county at critical stages.

The reservoirs constructed and operated in the Grand River system have altered the regime of streamflow from a widely fluctuating one, with high freshet flows and low summer flows, to a reasonably regulated regime with improved low flows. The records of the streamflow gauging station on the Grand River at Galt show this very clearly.

Additional reservoirs such as those proposed at Ayr and West Montrose would provide additional water storage and further improve water management. In 1964, J. M. Tomlinson and Associates Limited, Consulting Engineers, prepared a report entitled "General Report on West Montrose and Ayr Reservoirs" for the Grand River Conservation Commission. This report states: "The present reservoir storage capacity is insufficient to sustain flows during January and February every year, and it is not enough to defend the riverside municipalities during the hurricane or tropical storm season because, at that time, the reservoirs would normally be more than half full".

2. Water Uses

Limited use is made of surface waters in the county for water-supply purposes. None of the municipalities relies on surface water for municipal water requirements other than for fire fighting. The streams are used for livestock watering, irrigation, recreation and industrial purposes.

The major water takings are listed according to stream and purpose in Table 3-5. A number of these water takings are authorized under permits issued by the OWRC. At the end of 1964 there were six irrigators within the county holding permits to take water from streams, stream-fed ponds and dug-out ponds fed by ground-water seepage. Of these, three permits were for irrigation of golf courses, two for irrigation of tobacco and one for irrigation of cemetery grounds.

Extensive use is made of streams for dilution and assimilation of treated and untreated wastes discharged by municipalities and industries and as an outlet for natural and storm drainage systems. The importance of these uses will increase with urban and industrial development.

Some interest has been shown in the use of the Grand River or its tributaries as sources for future municipal water supplies. In such planning, items for consideration include the quality of the surface waters, the location of intakes or infiltration systems in relation to urban and industrial areas, and the reliability and depletion of streamflow.

Even as more storage is provided through the construction of dams and reservoirs, streamflows needed to maintain satisfactory conditions in streams where effluents from water pollution control plants are discharged will increase. These needs must be recognized when consideration is being given to the use of inland streams or reservoirs as sources of water supply.

For metropolitan areas in southwestern Ontario the Great Lakes will ultimately be used to meet urban water requirements. This applies to the County of Waterloo.

3. Water Quality

(a) Sanitary-Chemical

The water quality of the Grand River upstream from the Kitchener-Waterloo area is generally satisfactory. Some deterioration in quality is noted between Kitchener and Preston, with little change exhibited as far downstream as the southern limits of Galt. However, at Glen Morris, just south of the county boundary, there is marked improvement.

That part of the Nith River which is within the county is satisfactory. Cedar Creek, which discharges to the Nith River at Ayr, is of satisfactory quality.

The water quality in the upper reaches of Alder Creek, downstream from Petersburg, is unsatisfactory. Pollution was exhibited downstream from New Dundee in 1960 and 1962, but corrective measures in the form of industrial waste treatment have since eliminated the pollution.

Some pollution is evident in Baden Creek immediately downstream from Baden.

The water quality of Mill Creek at various points within Galt is generally satisfactory.

Fairly extensive pollution is exhibited in the Speed River downstream from Hespeler as well as at its confluence with the Grand River.

Evidence of contamination is exhibited in Schneider Creek as it flows through Kitchener. Some natural recovery is noted further downstream at a sampling point in the Township of Waterloo.

A small degree of pollution is noted in Laurel Creek at

Bridgeport at the confluence of the creek with the Grand River.

Adverse water quality is noted in Canagagigue Creek immediately upstream from Elmira. Further deterioration occurs as the creek flows through the town. Some natural improvement is noted downstream from Elmira, but the quality does not meet the Commission's objectives.

The water quality of the Conestogo River is generally satisfactory according to the available sample analyses.

A summary of the results of samples obtained from streams within the individual municipalities is presented in the respective municipal chapters. Reference should be made to these chapters for more detailed information. The locations of sampling points are shown on Figure 3-4 or on the individual municipal figures.

(b) Chemical and Physical

Table 3-6 lists the results of chemical and physical analyses performed at the OWRC laboratories on two sets of samples which were taken from a number of streams within the county. This table gives the locations of the sampling points which are plotted on Figure 3-4.

This table shows that the surface waters in the county range from moderately hard to very hard. The waters of the Speed River, the Nith River and its tributaries, which drain more pervious soils than the Conestogo and Grand rivers, have higher and more uniform hardness. This may be due to greater ground-water discharge. The Conestogo River in particular has a wide range of hardness. The second sample which was taken 83 days after the first one showed an increase in hardness in excess of 50 per cent.

The waters sampled have in nearly all cases more colour than that recommended for treated drinking water; similarly the iron contents are, in a number of cases, above the maximum recommended limit.

V CONSERVATION AGENCIES

1. The Grand River Conservation Commission

The Grand River Conservation Commission was established by the Grand River Conservation Act, 1938. Four of the eight member municipalities lie within the County of Waterloo and are the cities of Kitchener, Galt, and Waterloo and the Town of Preston. Its main purpose is to construct and operate

dams for flood control and the conservation of public water supplies. Streamflow is regulated by the release of stored water to supplement natural low flows to provide sufficient water for municipal water supply and waste-dilution needs. The Conservation Commission has constructed the Shand, Luther and Conestogo dams and reservoirs, having a total storage capacity of 105,000 acre-feet.

In June 1964 the Grand River Conservation Commission submitted to the federal and provincial governments a report entitled "Plan for Flood Control and Water Conservation in the Grand River Watershed". In addition to flood-control problems, the report deals with the continuing need to use the river to carry away water-borne wastes and states that additional conservation water storage is required to supplement low flows and thereby improve the quality of the river water.

To help meet this and other requirements, the Commission proposed the construction of dams and reservoirs at West Montrose and Ayr with storage capacities of 55,790 and 83,130 acre-feet respectively. The summary below is reproduced from the report and shows the low flows at various return periods which may be expected at Galt if the proposed dams are constructed.

Return Period (years)	Sustained Flow June-February (cfs)
1 in 50	385
1 in 25	420
1 in 10	480
1 in 3	625
average	900

The flows in this table may be compared with the long-term low flow experienced in the Grand River at Galt which is recorded as 26 cfs in 1936.

Listed below are the reservoirs constructed, proposed or under study by the Grand River Conservation Commission with estimated capacities and project status.

Reservoir	Capacity (Ac-ft)	Status
Shand	49,600	constructed 1942
Luther	10,000	constructed 1954
Conestogo	45,060	constructed 1958
Ayr	83,130	proposed 1970 construction
West Montrose	55,790	proposed 1965 construction
Nithburg		future available site

2. Grand Valley Conservation Authority

The Grand Valley Conservation Authority has jurisdiction over the entire drainage basin of the Grand River. The Authority was established on February 26, 1948, under The Conservation Authorities Act. Because of the role of the Grand River Conservation Commission, an agreement was reached whereby the Commission looks after the building of large dams and confines its other conservation activities to Commission lands. The Authority is concerned with reforestation, land-use problems, wildlife, recreation and flood-control measures as well as the construction of dams.

The reservoirs proposed or under study by the Authority both above and in the county are summarized below.

Reservoir	River	Capacity (Ac-ft)	Status
Everton	Eramosa	-	under study
Arkell	Eramosa	-	under study
Barrie Hill	Speed	-	under study
Guelph	Speed	-	under study
Hespeler	Speed	-	under study
Laurel Creek	Laurel Creek	2,120	proposed early construction

3. The Conservation Authorities Branch

The Conservation Authorities Branch*, Department of Energy and Resources Management, prepared a number of conservation reports that pertain to the Grand River basin. They are as follows:

Nith Valley Conservation Report, 1951
Speed Valley Conservation Report, 1953
Grand Valley Conservation Report, 1954
Grand River Conservation Report (Hydraulics),
First Edition, 1954
Second Edition, 1962
Whiteman Creek Conservation Report, 1962

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* This branch was previously in the Department of Lands and Forests and at earlier dates was the Conservation Branch with the departments of Commerce and Development and Planning and Development.

Of these, the Grand River Conservation Report (Hydraulics) is of particular interest. It presents plans for reservoirs and other conservation measures for consideration by both the Grand River Conservation Commission and Grand Valley Conservation Authority.

VI CONCLUSIONS

The availability of water of sufficient quantity and satisfactory quality to meet the growing water-use requirements is essential for the continued development of the county.

Ground water is the main source of the county's water supply. Its availability is generally good throughout the county except that water-quality problems are experienced locally. The Salina formation, especially near the Grand River, generally yields ground water of unsatisfactory quality. Ground-water extraction is greatest in the metropolitan areas.

The present rate of ground-water consumption approaches one-half the recharge that has been estimated to infiltrate into the aquifers within the boundaries of the county. It is possible that with increased usage additional ground-water flow may be induced from recharge areas beyond the county's boundaries, thereby making more water available for use. Increased development of ground water would result in some reduction of streamflow which would be most noticeable during periods when streamflow is dependent on ground-water discharge.

Whereas limited use is made of the Grand River and its tributaries for water-supply purposes they are used extensively for the removal and assimilation of liquid wastes.

This use has resulted in the degradation of stream quality in local areas; however, in all known areas of pollution, investigations and negotiations for its control are continuing, or corrective measures are being undertaken. As the county continues to develop the use of streams for waste assimilation will increase and additional dilution water will be required. In this regard the present reservoirs and those planned for the future will play an important role in the development of the water resources of the area.

A comprehensive study of the water resources should be undertaken in the County of Waterloo and region to assess further the availability of both ground and surface waters and to determine the optimum utilization of these resources.

TABLE 3-1

GROUND WATER QUALITY - COUNTY OF WATERLOO

Well* No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
				TOWNSHIP OF WELLESLEY (W½) - OVERBURDEN						
1	VII	4	75	-	292	262	0.24	14	7.7	43
				TOWNSHIP OF WELLESLEY (E½) - OVERBURDEN						
2	XII	5	126	-	780	186	1.36	12	7.6	970
3	VII	9	367	-	152	206	0.77	7	7.9	
4	VII	2	-	-	548	350	0.13	4	7.3	
				VILLAGE OF WELLESLEY - OVERBURDEN						
5			165	-	219	239	0.99	1.7	7.8	61
				TOWNSHIP OF WOOLWICH - OVERBURDEN						
6	G.C.T.	114	121	-	652	182	1.88	6	7.3	930
7	G.C.T.	100	75	-	220	226	0.40	4	7.5	
8	G.C.T.	86	92	-	284	232	0.40	4	7.6	40
9	G.C.T.	72	4 (Spring)	-	322	240	0.38	60	7.7	47
10	G.C.T.	129	87	-	164	190	0.12	5	7.8	50
11	Cooks T.B.F.	4	90	-	484	220	2.06	20	7.8	289
12	G.C.T.	31	22	-	352	282	0.10	119	7.7	44
13	G.C.T.	36	125	-	513	238	1.32	21	7.8	
14	G.C.T.	18	135	-	1650	192	1.80	12	7.3	

TABLE 3-1 (CONT'D)

Well No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
			TOWNSHIP OF WATERLOO - OVERBURDEN							
15	G.C.T.	61,62	186	-	1010	154	1.90	8	7.6	
16	G.C.T.	125	114	-	300	244	0.2	13	7.7	
17	G.C.T.	76	139	-	280	244	5.5	37	7.9	51
18	G.C.T.	35	81	-	270	234	2.56	10	7.9	
19	G.C.T.	115	92	-	187	221	0.22	3	7.9	
20	G.C.T.	115	92	-	230	256	0.43	2	7.9	
21	G.C.T.	119	102	-	500	270	0.10	14	7.9	
22	G.C.T.	102	117	-	280	238	0.28	9	7.8	
23	G.C.T.	147	205	-	484	158	0.92	3	7.8	
24	Bechtels T.		-	-	254	226	1.42	6	7.7	
25	B.B.F.	9	129	-	370	208	0.43	24	7.9	
26	B.B.F.	19	125	-	224	212	0.48	4	7.7	
27	B.B.F.	27	88	-	204	204	0.98	3	7.7	
28	B.N.S.	11	133	-	280	232	0.10	4	7.8	
29	B.N.T.	8	170	-	212	207	0.54	3	7.9	
30	B.N.T.	2	136	-	428	226	2.2	8	7.5	
31	Bechtels T.		85	-	240	228	0.35	4	7.9	
32	B.U.T.		122	-	1240	174	5.00	3	7.2	
33	B.O.S.	10	107	-	480	218	4.35	7	7.5	
34	B.O.S.	6	119	-	1360	170	2.7	4	7.2	
			TOWNSHIP OF NORTH DUMFRIES - OVERBURDEN							
35	VIII	21	86	-	268	236	0.03	10	8.0	42

TABLE 3-1 (CONT'D)

Well No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
				VILLAGE OF AYR - OVERBURDEN						
36			168	-	288	243	0.62	4	7.8	
				TOWNSHIP OF WILMOT - OVERBURDEN						
37	Block A	III 6	50	-	268	254	0.02	5	7.6	30
38	Block A	II 6	114	-	400	174	1.84	4	7.9	
39	Block A	I 10	186	-	210	198	0.18	4	8.1	
40	B.R.N.	19	53	-	406	258	0.88	Trace	7.5	
41	B.R.N.	16	-	-	272	232	0	60	7.9	
42	S.R.S.	14	55	-	268	223	0.04	8	7.8	
43	S.R.S.	9	49	-	270	246	0.08	11	7.8	
44	S.R.S.	7	100	-	290	234	0.12	22	8.0	
45	S.R.N.	5	284	-	128	166	0.48	6	8.1	
46	S.R.N.	1	163	-	270	234	0.25	5	7.9	
47	E.R.S.	1	121	-	216	214	0.6	11	-	
48	E.R.S.	3	102	-	236	212	1.6	7	-	
49	E.R.N.	7	172	-	277	242	0.19	13	7.6	
50	E.R.N.	7	166	-	284	242	0.38	13	7.6	
51	S.R.S.	21	14	-	1350	252	4.4	7	7.3	
				VILLAGE OF NEW HAMBURG - OVERBURDEN						
52			111	-	1200	-	4.0	-	-	
53			-	-	1940	194	0.18	6	7.1	

TABLE 3-1 (CONT'D)

Well No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
				TOWNSHIP OF WATERLOO - GUELPH FORMATION						
54	G.C.T.	99	113	31	164	198	0.05	12	7.8	48
55	G.C.T.	108	131	4	272	188	0.32	5	7.6	140
56	G.C.T.	104	174	60	300	188	1.24	10	7.9	
57	G.C.T.	115	151	41	380	228	2.04	7	7.9	
58	G.C.T.	111	131	15	370	204	1.60	7	7.8	
59	B.B.F.	30	170	74	150	176	0.20	Trace	7.8	
60	B.L.B. I	8	230	194	500	208	0.13	17	7.3	
61	B.B.F.	18	235	96	1180	178	4.35	83	7.6	967
				TOWN OF PRESTON - GUELPH FORMATION						
62			102	70	244	224	0.30	5	7.6	
				TOWNSHIP OF N. DUMFRIES - GUELPH FORMATION						
63	X	15	196	2	258	250	0.27	8	7.9	30
64	IX	7	240	68	258	244	1.52	12	8.0	32
65	X	4	117	34	322	264	1.10	18	7.9	63
				TOWNSHIP OF WELLESLEY W½ - SALINA FORMATION						
66	XI	9	216	-	145	205	0.68	4.5	7.9	
67	X	9	236	19	192	223	1.04	3	7.6	
68	XI	10	240	18	193	222	0.92	4	7.6	
				TOWNSHIP OF WELLESLEY E½ - SALINA FORMATION						
69	A	11	281	36	280	230	0.35	6	7.7	

TABLE 3-1 (CONT'D)

Well No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
				TOWNSHIP OF WOOLWICH - SALINA FORMATION						
70	G.C.T.	96	208	2	196	210	0.40	Trace	7.8	
71	G.C.T.	36	164	26	210	198	0.40	0	7.6	40
72	G.C.T.	80	145	16	162	176	1.60	Trace	7.8	27
73	B.F. I	3	149	31	1600	190	1.68	16	7.7	1370
				TOWNSHIP OF WILMOT - SALINA FORMATION						
74	Block B, I	6	348	4	156	250	1.19	30	7.8	
75	Block A, III	6	213	13	1437	149	5.5	3	7.3	
76	Block A, III	6	181	7	1550	163	0.30	6	7.9	
				TOWNSHIP OF WATERLOO - SALINA FORMATION						
77	G.C.T.	121	118	11	251	219	0.4	3	7.8	
78	B.B.F.	23	138	10	210	210	0.60	7	7.7	
79	B.U.T.		130	3	1540	196	0.82	4	7.2	
80	B.O.S.	4	116	17	710	206	3.50	5	7.4	
				CITY OF WATERLOO - SALINA FORMATION						
81			146	14	1450	182	0.19	15	7.3	
				TOWN OF PRESTON - SALINA FORMATION						
82			110	5	680	204	1.20	7	7.5	

TABLE 3-1 (CONT'D)

Well No.	Location of Well Conc.	Lot	DEPTH of Well (ft)	DEPTH in Rock (ft)	ANALYSIS Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Sulphate as SO_4
			TOWNSHIP OF N. DUMFRIES - SALINA FORMATION							
83	VIII	38	227	7	1690	168	5.6	9	7.3	1490
84	IX	34	301	53	1870	192	37.6	82	7.5	1540
85	IX	25	302	12	390	232	3.0	9	7.9	162
			TOWNSHIP OF WELLESLEY W½ - BASS ISLAND AND BOIS BLANC FORMATIONS							
86	VI	3	230	12	212	240	0.87	20	7.8	9
87	II	12	308	41	370	211	0.21	3	8.1	
88	III	1	192	50	218	270	1.64	15	7.6	5
89	V	9	267	42	312	300	0.11	16	7.7	29
90	I	8	219	11	144	240	0.86	15	7.8	7
			VILLAGE OF WELLESLEY - BASS ISLAND							
91			228	30	188	236	1.67	1.5	7.9	
92			231	33	200	240	0.64	1.5	7.9	
			TOWNSHIP OF WILMOT - BASS ISLAND AND BOIS BLANC FORMATIONS							
93	III	20	185	34	190	220	0.50	10	7.8	29
94	S.B.R.	22	131	9	238	238	0.49	5	7.8	26
95	N.B.R.	27	210	35	154	198	0.40	Trace	7.8	
96	II	26	251	52	242	236	1.28	Trace	7.5	

NOTE: Analyses of samples from municipal wells are included in the chapters for the individual municipalities. Analyses from private water works are included in this table. Well numbers listed on the following page correspond to the following private water works. All analyses except pH are in ppm.

TABLE 3-1 (CONT'D)

Well Number*	Name of Private Water Works System
5	Wagner Water Works
13	Good Subdivision Water Works
14	Martin's Grove Mobile Home Park Water Works
15	Colonial Acres Water Works
16	Schweitzer Subdivision Water Works
23	Elroy Acres Water Works
29	Chalon Estates Water Works
49	Schwartzentruber Water Works
50	Hannon Water Works
66	Linwood Water Works
67	Ogram Water Works
68	Luntz Water Works
75	Hamacher Water Works
77	Eastmount Subdivision Water Works
91	Lichti Water Works
92	Erb Water Works

* refers to well shown on Figure 3-2

TABLE 3-2

SUMMARY OF GROUND WATER QUALITY - COUNTY OF WATERLOO

Aquifer	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)	Sulphate as SO_4 (ppm)
Overburden	128	154	0	trace	7.2	0	0
	to	to	to	to	to	to	to
	1650	350	5.5	200	8.1	0.4	970
Bedrock							
Bois Blanc and	144	211	0.11	trace	7.5	-	0
Bass Island	to	to	to	to	to		to
	370	300	1.67	20	8.1	-	29
Salina	145	149	0.02	0	7.1	0	0
	to	to	to	to	to	to	to
	1940	254	37.60	82	7.9	1.4	1540
Guelph	150	176	0.05	trace	7.3	0.1	0
	to	to	to	to	to	to	to
	1180	306	4.35	83	7.9	0.9	186

TABLE 3-3

SUMMARY OF STREAMFLOW GAUGING STATIONS DATA

Station* Number	Stream	Location	Drainage Area (sq mi)	Period of Continuous Record	Present Gauge Type	Average Annual Discharge (cfs)
2GA27	Grand River	above Lake Belwood	292	Oct. 1961 to date	recording	-
2GA16	Grand River	below Shand Dam	309	Oct. 1951 to date	recording	268
2GA17	Conestogo River	at Drayton	125	May 1950 to date	recording	118
2GA28	Conestogo River	at Glen Allan	223	Oct. 1959 to date	recording	176
2GA13	Conestogo River	near Conestogo	317	Apr. 1947 to Oct. 1958	recording discontinued	324
2GA23	Canagagigue Creek	near Elmira	45	Jan. 1958 to date	recording	30
2GA24	Laurel Creek	at Waterloo	23	June 1959 to date	recording	11
2GA15	Speed River	below Guelph	229	Apr. 1950 to date	recording	186

TABLE 3-3 (CONT'D)

Station* Number	Stream	Location	Drainage Area (sq mi)	Period of Continuous Record	Present Gauge Type	Average Annual Discharge (cfs)
2GA3	Grand River	at Galt	1,360	July 1913 to date	recording	1,174
2GA18	Nith River	at New Hamburg	209	May 1950 to date	manual	185
2GA10	Nith River	near Canning	398	June 1947 to date	recording	355

* station number used by Department of Northern Affairs and National Resources, Water Resources Branch

TABLE 3-4

SUMMARY OF ANNUAL FLOW DATA FOR THE GRAND RIVER AND TRIBUTARIES

Period of Continuous Record	Extremes of Continuous Annual Records	Maximum Day (cfs)	Average Day (cfs)	Average Summer* (cfs)	Minimum Month (cfs)	Minimum Summer Month (cfs)	Minimum 7-Day (cfs)	Minimum Day (cfs)
		STATION NO. 2GA27-GRAND RIVER ABOVE LAKE BELWOOD						
1962-1964	Maximum	6,180	213	47.1	7.6	10.6	5.1	5.0
	Minimum	3,350	126	27.9	5.8	6.5	3.5	2.9
		STATION NO. 2GA16-GRAND RIVER BELOW SHAND DAM						
1952-1964	Maximum	5,430	431	329	165	222	76	51
	Minimum	717	121	136	12.2	48	9	0
		STATION NO. 2GA17-CONESTOGO RIVER AT DRAYTON						
1950-1964	Maximum	5,540	189	74	14	25	7	2
	Minimum	1,140	69	2.9	0.9	0.9	0.2	0
		STATION NO. 2GA28-CONESTOGO RIVER AT GLEN ALLAN						
1960-1964	Maximum	7,600	374	181	98	158	43.6	39.6
	Minimum	829	116	123	3.5	3.5	2.2	2.0
		STATION NO. 2GA13-CONESTOGO RIVER NEAR CONESTOGO						
1947-1958	Maximum	20,900	447	211	48	75	22	18
	Minimum	3,870	200	10	9	7	6	4

TABLE 3-4 (CONT'D)

Period of Continuous Record	Extremes of Continuous Annual Records	Maximum Day (cfs)	Average Day (cfs)	Average Summer* (cfs)	Minimum Month (cfs)	Minimum Summer Month (cfs)	Minimum 7-Day (cfs)	Minimum Day (cfs)
		STATION No. 2GA23-CANAGAGIGUE CREEK NEAR ELMIRA						
1958-1964	Maximum	1,000	51	22	5.1	6.2	4.1	3.5
	Minimum	298	19.2	3.6	2.5	2.5	1.5	0.4
		STATION NO. 2GA24-LAUREL CREEK AT WATERLOO						
1960-1964	Maximum	340	12.6	8.1	5.1	4.7	1.8	0.4
	Minimum	109	10.3	3.4	1.6	2.7	0.1	0.0
		STATION NO. 2GA15-SPEED RIVER BELOW GUELPH						
1950-1964	Maximum	6,720	299	255	95	153	50	40
	Minimum	870	107	33.9	27.5	31.8	10.1	0.0
		STATION NO. 2GA3-GRAND RIVER AT GALT						
1913-1942	Maximum	30,090	1,790	982	207	294	191	144
	Minimum	6,630	483	47	47	47	37	26
1943[a]-1953	Maximum	37,700	2,010	1,091	425	610	313	295
	Minimum	12,600	962	308	211	252	130	88
1954[b]-1958	Maximum	40,300	1,750	1,139	592	773	428	389
	Minimum	12,000	847	423	332	332	242	222

TABLE 3-4 (CONT'D)

Period of Continuous Record	Extremes of Continuous Annual Records	Maximum Day (cfs)	Average Day (cfs)	Average Summer* (cfs)	Minimum Month (cfs)	Minimum Summer Month (cfs)	Minimum 7-Day (cfs)	Minumum Day (cfs)
		STATION NO. 2GA3-GRAND RIVER AT GALT (CONT'D)						
1959c-1964	Maximum	24,000	1,700	810	706	706	424	405
	Minimum	4,490	659	476	275	427	270	155
		STATION NO. 2GA18-NITH RIVER AT NEW HAMBURG						
1950-1964	Maximum	7,520	292	123	42	74	29	22
	Minimum	2,180	115	13.2	8.6	8.6	3.4	0
		STATION NO. 2GA10-NITH RIVER NEAR CANNING						
1947-1964	Maximum	11,600	520	312	135	216	85	75
	Minimum	2,920	194	69	57.3	60	49	20

* - 4-month period beginning June 1 to September 30
a - Shand Dam and Reservoir placed in operation
b - Luther Dam and Reservoir placed in operation
c - Conestogo Dam and Reservoir placed in operation

The streamflow data used in this analysis were tabulated and analyzed for each water year and for smaller intervals within a water year. A water year is a 12-month period from October 1 to September 30. Annual as used in this table refers to a water year.

The starting year of records as listed in column 1 refers to the calendar year in which the water year ended.

TABLE 3-4 (CONT'D)

Data for analysis were obtained from streamflow data published in the annual reports of the Hydro-Electric Power Commission of Ontario, 1913-1918; from Water Resources Papers published respectively by the Department of the Interior, 1919-1931; the Department of Mines and Resources, 1932-1945; the Department of Resources and Development, 1946-1951; and the Department of Northern Affairs and National Resources, 1952-1962; and from provisional streamflow data supplied by Water Resources Branch, Department of Northern Affairs and National Resources, 1962-1964.

TABLE 3-5

MAJOR SURFACE WATER TAKINGS

Stream	Purpose				Comments	Municipality
	Industry (gpd)	Irrigation (gpd)	Recreation			
Grand River	500,000	-	-		gravel washing-water returned through settling tank to river	Township of Waterloo
Grand River	-	97,000	-	p	golf course	Township of Waterloo
Schneider Creek	-	-	s	p	filling recreational reservoir	Township of Waterloo
Galt Creek	150,000	-	-		processing	City of Galt
Canagagigue Creek	280,000	-	-		cooling and boiler use	Town of Elmira
Canagagigue Creek	1,000,000	-	-	p	cooling and processing - only 30,000 used in processing the remainder returned to stream (in 1964 no creek water used)	Town of Elmira

TABLE 3-5 (CONT'D)

Stream	Purpose: Industry (gpd)	Irrigation (gpd)	Recreation		Comments	Municipality
Conestogo River	79,200	-	-		Cannery-operates during certain periods of year and at different capacities - cooling and processing	Township of Woolwich (Police Village of St. Jacobs)
Speed River	1,250,000	-	-		dilution and processing	Town of Hespeler
Speed River	800,000	-	-		processing	Town of Hespeler
Speed River	-	63,000	-		golf course	Township of Waterloo
Nith River	-	200,000	-	p	tobacco	Township of N. Dumfries
Nith River	-	281,667	-	p	tobacco	Township of Wilmot
Nith River	-		s	p	filling recreational reservoir	Township of Wilmot
Washington Creek Creek	-		s	p	fire protection-filling on-stream reservoir	Township of Wilmot

p - taking authorized by permit
s - taking is into storage on stream, amount is not specific

TABLE 3-6

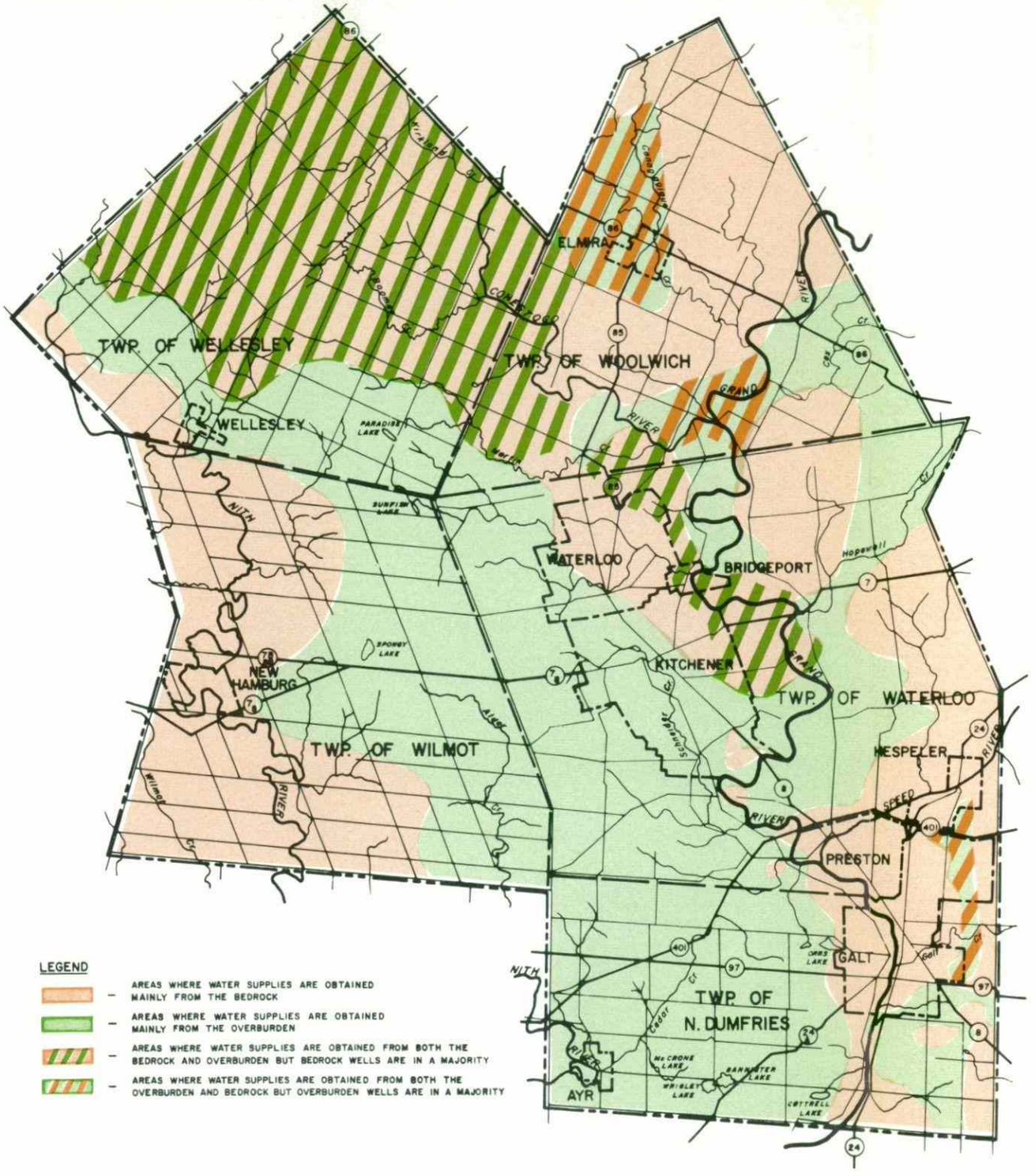
CHEMICAL AND PHYSICAL QUALITY OF SURFACE WATERS

Sampling Point No.	Date of Sample	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Calcium as Ca (ppm)	Magnesium as Mg (ppm)	Sodium as Na (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Conductivity (Micromhos per cm)	Apparent Colour Units	Turbidity Units
GRAND RIVER AT BRIDGEPORT BRIDGE												
G 110.3	4.3.65	144	112	42	9	4.4	0.37	14	7.5	255	35*	5.5
	26.5.65	190	147	50	16	3.8	0.08	11	8.3	340	25	1.8
GRAND RIVER AT HIGHWAY 86												
G 124.3	4.3.65	146	116	43	9	3.9	0.22	15	7.9	260	35*	1.4
	26.5.65	178	150	50	13	2.4	0.20	9	8.3	310	25	1.4
CONESTOGO RIVER AT HAWKESVILLE												
GCO 129.2	4.3.65	114	100	31	9	3.9	1.90	14	7.9	210	45*	39
	26.5.65	176	132	45	15	3.0	0.19	9	8.2	320	10	1.8
CONESTOGO RIVER 0.75 MILES UPSTREAM FROM MOUTH												
GCO 118.9	4.3.65	118	102	35	7	3.8	1.09	14	7.8	220	45*	20
	26.5.65	188	137	44	19	3.5	0.21	10	8.3	340	10	2.1
NITH RIVER AT SHADE STREET BRIDGE NEW HAMBURG												
GN 133.2	4.3.65	268	224	80	16	6.1	0.25	19	7.8	440	25	3.3
	26.5.65	250	212	71	18	4.7	1.22	11	8.5	425	35	24

TABLE 3-6 (CONT'D)

Sampling Point No.	Date of Sample	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Calcium as Ca (ppm)	Magnesium as Mg (ppm)	Sodium as Na (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Conductivity (Micromhos per cm)	Apparent Colour Units	Turbidity Units
NITH RIVER UPSTREAM FROM AYR												
GN 105.8	26.5.65	270	132	73	21	5.4	0.62	15	8.8	410	50	9
ALDER CREEK 0.75 MILES UPSTREAM FROM NEW DUNDEE												
GNA114.0	4.3.65	248	212	76	14	5.8	0.17	20	8.1	420	10	1.8
	26.5.65	208	166	52	19	3.9	0.35	11	8.8	370	25	4.0
CEDAR CREEK UPSTREAM FROM AYR												
GNC103.9	27.5.65	272	191	72	22	4.2	0.20	14	8.3	460	5	1.8
SPEED RIVER AT DAM IN HESPELER												
GSP 98.4	4.3.65	274	224	68	25	4.4	0.24	59	7.9	630	15	2.0
	27.5.65	272	231	72	22	16.8	0.38	59	7.5	540	35	6.5

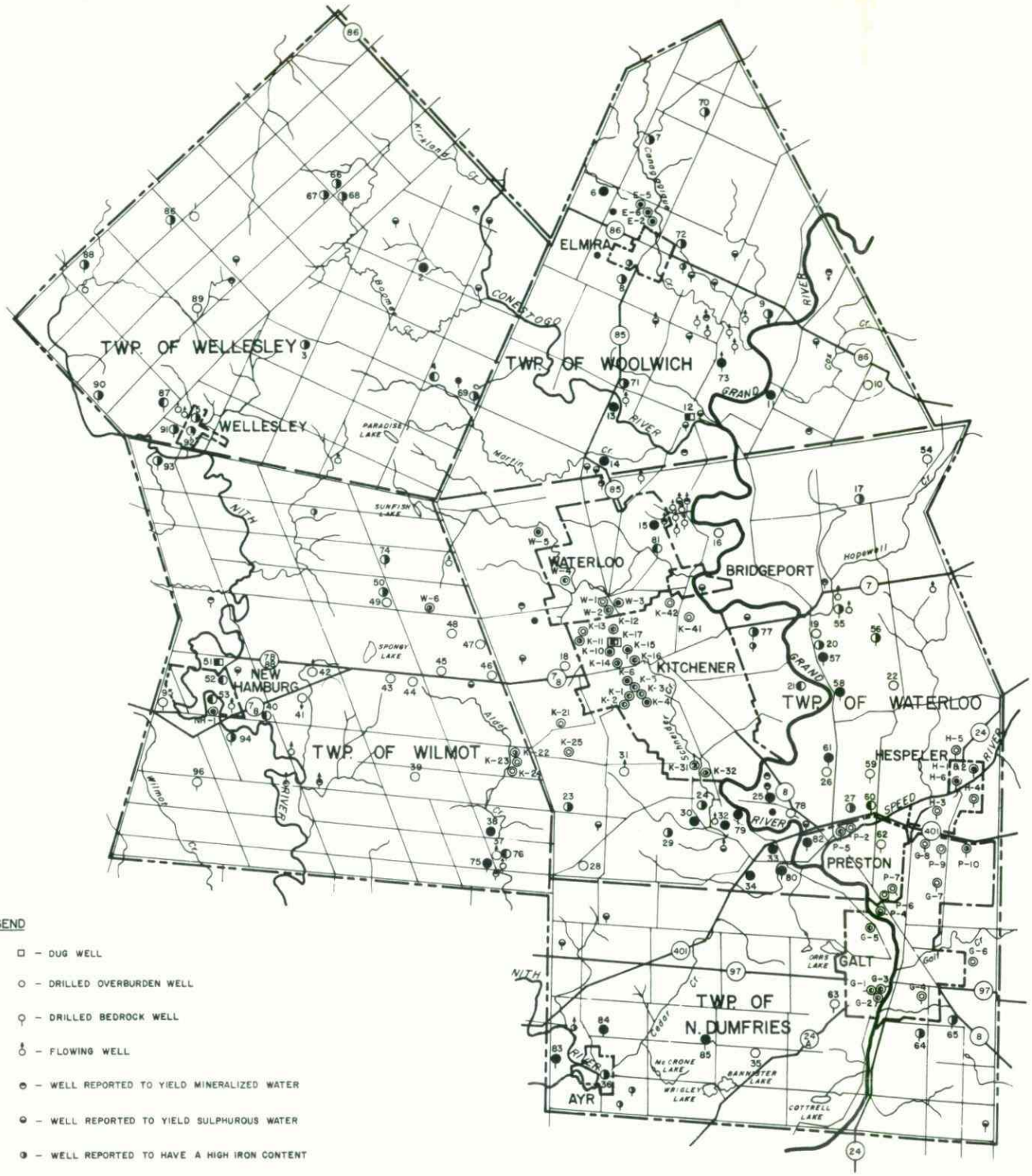
* test performed on settled sample



ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO
MAIN SOURCES OF WATER SUPPLY FOR DRILLED WELLS
FIGURE 3-1

SCALE: 1 0 1 2 3 MILES	
DRAWN BY: L.L.B	DATE: JAN., 1966
CHECKED BY: A.Y.	DRAWING No: 66-5



LEGEND

- □ – DUG WELL
- ○ – DRILLED OVERBURDEN WELL
- ♀ – DRILLED BEDROCK WELL
- ♁ – FLOWING WELL
- ◓ – WELL REPORTED TO YIELD MINERALIZED WATER
- ◒ – WELL REPORTED TO YIELD SULPHUROUS WATER
- ◑ – WELL REPORTED TO HAVE A HIGH IRON CONTENT
- ◑ – SAMPLED PRIVATE WELL HAVING WATER CONTAINING >0·3 P.P.M. IRON
- ◉ – SAMPLED MUNICIPAL WELL HAVING WATER CONTAINING >0·3 P.P.M. IRON
- ◐ – SAMPLED PRIVATE WELL HAVING WATER WITH >360 P.P.M. HARDNESS
- ◉ – SAMPLED MUNICIPAL WELL HAVING WATER WITH >360 P.P.M. HARDNESS
- ○ – SAMPLED PRIVATE WELL YIELDING BETTER QUALITY WATER
- ◎ – SAMPLED MUNICIPAL WELL YIELDING BETTER QUALITY WATER
- ♀ – SAMPLED SPRING

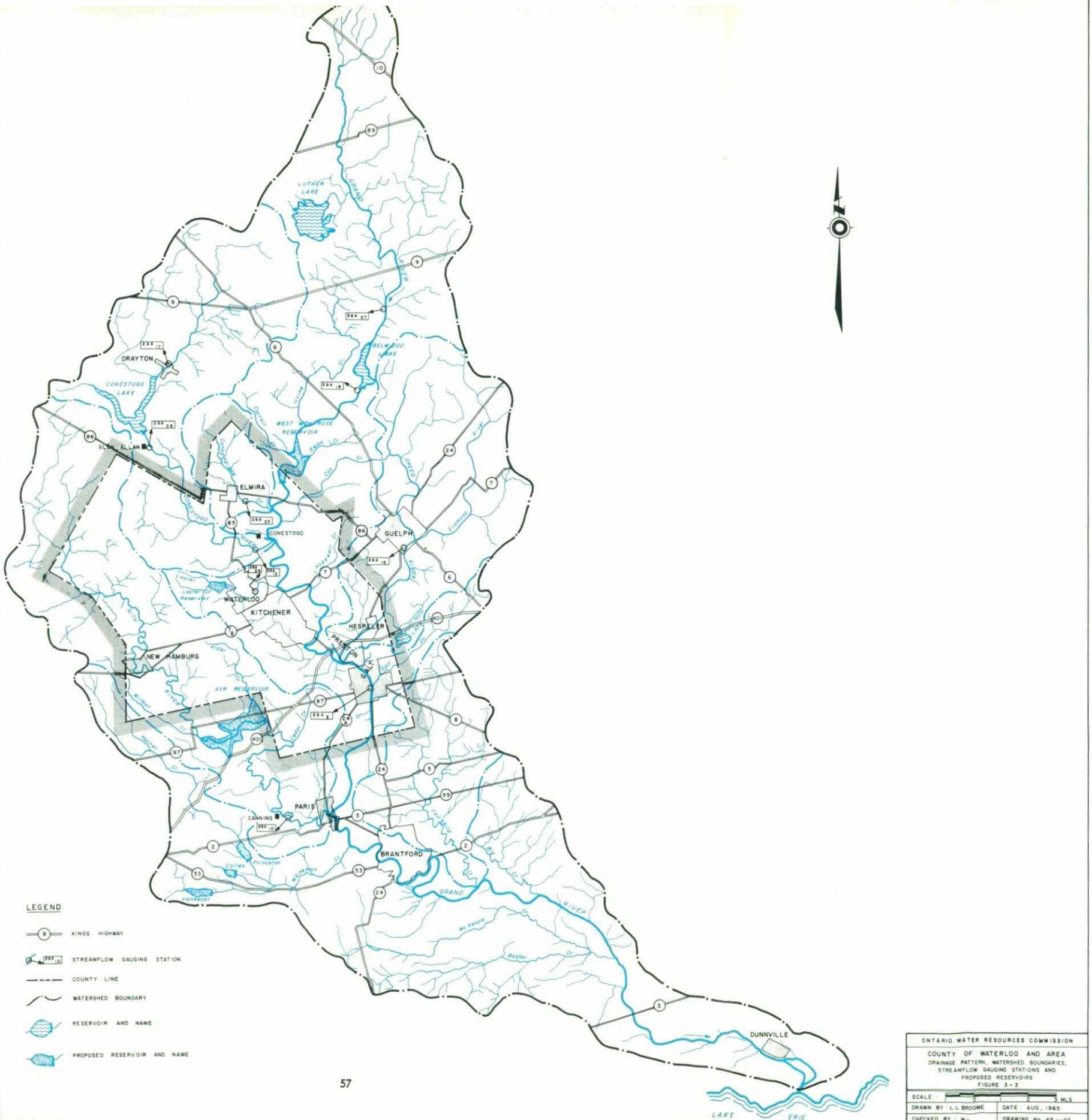
NOTE

CHEMICAL ANALYSES OF WATER SAMPLES FROM THE NUMBERED PRIVATE WELLS ARE SHOWN IN TABLE 3-1 AND FROM THE NUMBERED MUNICIPAL WELLS IN TABLES IN THE CHAPTERS DEALING WITH EACH MUNICIPALITY

ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO
CHARACTERISTICS OF WELLS
SAMPLED, REPORTEDLY MINERALIZED AND FLOWING
FIGURE 3-2

SCALE: 1 0 1 2 3 MILES	
DRAWN BY: L.L.B.	DATE: JAN., 1966
CHECKED BY: A.M.	DRAWING No: 66-5



ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO AND AREA
DRAINAGE PATTERN, WATERSHED BOUNDARIES, STREAMFLOW GAUGING STATIONS AND PROPOSED RESERVOIRS
FIGURE 3-3

SCALE : 0 1 2 3 MILS
DRAWN BY : L.L. BROOME | DATE : AUG., 1965
CHECKED BY : W.L. | DRAWING No : 65-107

LEGEND

GN-127·3 – SAMPLING POINT SHOWING STREAM AND MILEAGE

● – REFUSE DISPOSAL SITE

ONTARIO WATER RESOURCES COMMISSION

COUNTY OF WATERLOO

STREAM SAMPLING POINTS AND REFUSE DISPOSAL SITES

FIGURE 3 – 4

SCALE : 0 1 2 3 MILES	
DRAWN BY : L.L.B.	DATE : SEPT., 1965
CHECKED BY : A.C.	DRAWING No : 65-113

CHAPTER 4

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CHAPTER 4

CITY OF GALT

I GENERAL

The City of Galt is situated in the southeastern portion of the county. All drainage of the city is to the Grand River, which flows through the southwestern section of the city from north to south, and its tributary, Mill Creek.

Galt is a highly industrialized city, with some 32 industries providing facilities for manufacturing, metal finishing and steel fabricating.

The 1964 assessed population was 30,174.

II WATER SUPPLY

1. Municipal

(a) Source

The source of water for the original municipal water works system for Galt was from springs in the Middleton Street area. A collection gallery was constructed to receive the spring water. The first Middleton Street wells were drilled in 1891.

At the present time, the City of Galt obtains water from nine wells, which have a total rated yield of approximately 9.55 mgd. The well data are listed in Table 4-1. Three wells constructed from 1931 to 1951 are still operated in the Middleton Street well field. The other wells currently in operation were added during the period 1954 to 1965. The Back Hespeler Road and Pinebush Road wells were added to service the northern area. According to future plans, this area, particularly near Highway 401, will be industrial.

Wells 3 to 8, inclusive, are pumped directly into the system by means of high-lift, vertical centrifugal pumps, while wells 1 and 2 are pumped into a nearby storage reservoir by means of electrically driven, low-lift, vertical centrifugal pumps prior to distribution. Wells 1, 3, 4 and 7 are equipped with gasoline- or diesel-powered auxiliary motors. Well 9 is used as a standby for well 7.

(b) Treatment

No treatment is presently provided the water on a municipal basis. Many of the users provide water softening on an

individual basis.

(c) Water Pumpage

A summary of water pumpages from 1960 to 1964 inclusive is shown below:

Year	Total (mg)	Pumpage Avg. Day (mg)	Pumpage Max. Day (mg)	Per Capita (gpd)
1960	1,168.00	3.20	4.90	119
1961	1,158.44	3.16	5.02	115
1962	1,239.18	3.40	5.20	123
1963	1,331.28	3.65	6.26	127
1964	1,300.73	3.55	5.30	118

The estimated available yield from the present municipal wells is 9.55 mgd. It is noted from the foregoing figures that the average and maximum daily pumpages at the end of 1964 were well below the estimated available supply. The average daily pumpage has increased approximately 11 per cent from 1960 to 1964.

(d) Water Quality

The water from all the wells serving the city is generally satisfactory from a chemical-quality standpoint. The only chemical constituent which detracts from the overall satisfactory quality of the water is the high hardness. Only one well, the Blair Road well, exhibits an average fluoride content which approaches the level considered beneficial in the prevention of dental caries.

A summary of the analyses of samples collected for chemical-quality determination from 1961 to 1964 inclusive is shown in Table 4-2. The quality of the water from each of the wells has shown very little variation in quality over the sampling period. For this reason the summary contains only average values.

The bacteriological quality of the water has been satisfactory.

(e) Distribution and Storage

Water is distributed through 88 miles of mains ranging in size from 2 to 24 inches. There are approximately 7,000

domestic and 660 commercial and industrial services. The system is almost totally metered.

Services are provided to approximately 40 consumers beyond the municipal boundary in the Township of North Dumfries. Ten of the consumers are located on Highway 8 southeast of the city; the remaining 30 are in the Veterans' Land Act subdivision located east of the city.

Storage is provided by two elevated tanks with capacities of 0.22 and 0.79 mg, and two ground-level reservoirs with capacities of 0.15 and 2.50 mg.

2. Potential Additional Supplies

(a) Ground Water

Additional ground-water supplies can likely be obtained from both the overburden and the bedrock. As additional wells are added to the system the main factor will be spacing of the wells in order to take advantage economically of the available ground water without creating areas of overpumping.

The available information indicates that good wells may be developed in the overburden to the west and southeast of the city. The area to the west is quite extensive beginning about 1 mile west of Galt and extending beyond the Village of Ayr. The area to the southeast is more localized and includes the extreme southeast section of the city.

Rock wells, which should yield water comparable in quality to that which is now supplied to the city, may be developed in the area east of the Grand River. The Salina formation, which normally yields an extremely hard water, begins approximately 1.5 miles west of the Grand River. The presence of this formation will limit the development of rock wells in that direction.

The development of ground water in a limited area in the city east of the Town of Preston is covered by an agreement involving the municipalities of Galt and Preston and the Ontario Water Resources Commission.

(b) Surface Water

The use of the Grand River as an additional source of water supply for municipal water systems would depend upon its water quality and the quantity available for this purpose. It

may be expected that the quantity available will initially be increased through the construction of additional reservoirs; however, at some future time these waters will not be available for municipal water supply but will be needed as dilution water for the assimilation of wastes discharged into the river system. During this interim period, it may be feasible to develop the river resource for municipal water supplies. The best results would be obtained if a co-ordinated system were to be initiated with the intake at a storage reservoir on the river above urban areas.

A pipeline system supplying water from one of the Great Lakes should be considered as the ultimate solution to the water-supply problem of the urban municipalities in the county and adjacent areas and developed as local resources become fully utilized for supply or other purposes. The City of Galt should participate in such a scheme.

3. Future Requirements

The average per capita pumpage over the period from 1960 to 1964 has ranged as high as 127 gpd, with maximum pumpages up to 220 gpd. Based on the maximum per capita pumpage to date and the total available yield of the existing well fields, a population of approximately 43,000 could be adequately supplied during maximum-demand periods. According to the population projection figures presented in Chapter 2, this population will not be realized until about 1975.

III WATER POLLUTION

1. Pollution Control Facilities

General

Treatment for domestic and most industrial wastes is provided by a 5.0-mgd activated-sludge-type water pollution control plant. The plant has been in operation since May 1963 and was constructed under joint agreement between the city and the Ontario Water Resources Commission.

The treatment process consists of coarse screening, comminution, grit removal, primary settling, mechanical aeration, final settling, effluent chlorination, two-stage sludge digestion and digested-sludge vacuum filtration.

Almost the entire developed area of the city is served by sanitary sewers. One area, in the northwest portion of the

city, estimated to contain approximately 1 per cent of the total population, is served by individual septic tanks. Sewer services are scheduled for this area by the end of 1966, thus completing the services to the developed areas. A small area, consisting of approximately 10 dwellings, located at the city's southeast boundary in the adjacent Township of North Dumfries, is served by sewers which discharge to the Galt system of sewers.

Treatment Efficiency

A summary of operating efficiencies and the results of the analyses of samples of the raw sewage and final effluent from June 1963 to December 1964 is shown below:

Year	No. of Samples	5-Day BOD Avg. (ppm)	5-Day BOD Max. (ppm)	5-Day BOD Min. (ppm)	5-Day BOD Red. (%)	Suspended Solids Avg. (ppm)	Suspended Solids Max. (ppm)	Suspended Solids Min. (ppm)	Suspended Solids Red. (%)
1963*	13								
Raw Sewage		152	200	125		132	173	97	
Final Effluent		14	26	4	91	13	25	2	90
1964	24								
Raw Sewage		139	280	84		169	494	108	
Final Effluent		13	46	2	91	16	40	1	90

* June to December inclusive

The foregoing results suggest that the operation of the plant has been satisfactory. The reductions in BOD and suspended solids are in keeping with those expected from this type of plant.

Sewage Flow

A summary of flows received at the plant from June 1963 to December 1964 is shown below:

	1963*	1964**
Total Flow (mg)	1,041.11	1,265.14
Average Flow (mgd)	4.86	5.18
Maximum Flow (mgd)	6.43	8.00
Average Per Capita (gpd)	169	172
Sewage Flow to Water Consumption Ratio	1.33	1.46

* June to December inclusive
** totalizer inoperative September to December

It is noted that the average daily waste flow received at the plant during 1964 was slightly in excess of the 5.0-mgd design flow. However, this excess has not affected the operation of the plant, as shown by the operating results presented previously. The sewage flow to water consumption ratio is somewhat higher than expected and may be accounted for in part by the fact that many of the sewers are old, allowing ground-water infiltration, and many are combined, receiving storm water as well as wastewater.

2. Industrial Waste Disposal

The wastewater disposal practices of approximately 30 industries were investigated as part of the survey. Of the 30 investigated only 9 were found to have significant waste discharges. Domestic wastes from these nine industries are discharged to the sanitary sewers. Industrial wastes are discharged either to sanitary sewers, to seepage pits or through storm sewers and private drains to natural watercourses. A brief description of each of the nine industries, outlining the type of industry and the volume, method of disposal and character of the waste, is provided in Table 4-3.

Industrial wastes discharged to the sanitary sewers appear to present no problems. The main problems arise from plating and metal-finishing operations at three of the five industries whose wastes are not taken into the sanitary sewers. Two of these industries discharge process wastes to seepage pits, and to date no problems are evident from this disposal practice. The remaining three, whose wastes are discharged to natural watercourses, constitute sources of pollution.

The approximately 20 industries that have been investigated but are not included in Table 4-3 use up to 0.9 mgd of water for processing and cooling. The amount used depends on seasonal and production requirements. No significant waste loadings are contributed by these industries, and much of the waste flow, approximately 0.5 mgd, is cooling water, which is discharged to storm sewers.

3. Refuse Disposal

The municipal sanitary landfill site is located near the water pollution control plant. An embankment prevents contamination of the adjacent Grand River.

4. Surface-Water Quality

The results of the analyses of samples of storm sewer effluents within the city are shown in Table 4-4. The results indicate that polluting wastes are being discharged from several of the outlets. Two discharges that are particularly adverse are those from the River Street storm sewer and the Dixon Dairy Products Limited outlet. The latter discharge is expected to be eliminated in 1965 by re-directing the dairy's wastes to a sanitary sewer.

Water-quality data on the Grand River and Mill Creek are included in tables 4-5 and 4-6. The water quality of Mill Creek is satisfactory and in comparing the sample results of the Grand River upstream and downstream of the outfall discharges there is no evidence of deterioration in quality as the river passes through the city. The locations of storm sewer outlets and stream sampling points are shown on Figure 4-1.

5. Future Requirements

The municipal water pollution control plant is presently receiving average flows slightly in excess of the design flow. A sewer program to eliminate ground-water infiltration into the old sanitary sewers and to replace the combined sewers with separate sewers would substantially reduce the wastewater flows. The life expectancy of the plant would thereby be increased and the need for extension of the facilities delayed for some years.

The discharge of untreated domestic and industrial wastes to natural watercourses should be terminated. The most satisfactory method for disposing of these wastes is through the municipal system. Where industrial wastes are such as will cause operating difficulties at the municipal plant or affect the receiving sewer, pre-treatment or complete treatment may be required at the industry before discharge.

IV CONCLUSIONS

1. Water Supply

From the standpoint of both the chemical and bacteriological qualities, the present water supply is satisfactory. The quantity available will serve the present and near-future requirements but additional sources will be needed to satisfy the long-term requirements.

Future requirements may be satisfied using ground-water sources. However, as adjacent ground-water sources are fully developed it may prove more economical to participate with other municipalities in the area to obtain water from the Great Lakes. The quality of the Grand River water is such that extensive treatment would be required, and, in view of this, one of the Great Lakes is a more desirable surface-water source.

2. Water Pollution

The water pollution control on a municipal basis is for the most part satisfactory. Most of the industrial and domestic waste discharges in the city are directed to the municipal water pollution control plant. However, there are some discharges of untreated domestic and industrial wastes to storm sewers or directly to natural watercourses. A small area of the city is not served by sanitary sewers but sewers are expected for 1966. This area is presently served by individual septic tank systems which appear to function satisfactorily.

The water pollution control plant now receives average flows in excess of the design flow due to the large volume of storm and ground water entering the sanitary sewer system. A program to eliminate the access of this water to the sewers would increase the life expectancy of the present treatment facilities.

TABLE 4-1

CITY OF GALT - WELL DATA

Well	Name	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Rated Capacity (gpm)	Yield of Well or Field (mgd)
1	Middleton St. No.1	1931	198	18	Bedrock	1,750	6.00
2	Middleton St. No.2	1937	165	18	Bedrock	2,400	
3	Middleton St. No.3	1951	170	18	Bedrock	1,950	
4	Elgin St.	1954	253	12	Bedrock	435	0.62
5	Blair Rd.	1956	202	10	Bedrock	250	0.36
6	Clyde Rd. No.1	1959	58	10	Overburden	400	0.57
7	Back Hespeler Rd.	1960	274	12	Bedrock	350	0.50
8	Pinebush Rd.	1958	79	12	Bedrock	700	1.00
9	Clyde Rd. No.2	1964	58	--	Overburden	350	0.50
							9.55

TABLE 4-2

CITY OF GALT - CHEMICAL WATER QUALITY

Well	Well*** Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Middleton St.No.1	G-1	3	442	252	0.06	23	7.4	0.5*
Middleton St.No.2	G-2	5	380	267	0.04	32	7.4	0.3**
Middleton St.No.3	G-3	2	380	253	0.05	30	7.4	-
Hespeler Rd.	G-4	3	268	252	0.07	4	7.6	0.2
Pinebush Rd.	G-5	5	298	238	0.11	13	7.6	0.0**
Clyde Rd. No.1	G-6	4	302	249	0.04	10	7.6	0.1**
Elgin St.	G-7	6	325	259	0.06	11	7.4	0.1**
Blair Rd.	G-8	4	421	244	0.07	12	7.4	0.9

* one sample
** three samples
*** refers to well shown on Figure 3-2

TABLE 4-3

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES

CITY OF GALT

Industry	Type	Volume (gpd)	Disposal	Character of Wastes
Allen-Bradley (Canada) Limited	manufacturing (plating)	20,000	seepage pit	plating rinses containing chromium, copper, cadmium, cyanide
The Dobbie Industries Limited				
Newlands Division	textile	250,000	sanitary sewer	high BOD and solids
Stauffer-Dobbie Division	textile	330,000	sanitary sewer	high BOD and solids
Dominion Tack and Nail Company Limited	manufacturing (plating)	15,000	seepage pit	plating rinses high in copper, cyanide and nickel
Franklin Division, Studebaker Corporation of Canada Limited	manufacturing (metal finishing)	300,000	storm sewer	rinses from cleaning and painting line
Fromm Brothers Limited	textile	12,000	sanitary sewer	high BOD and solids
Galt Brass Limited	manufacturing (plating)	75,000	storm sewer	plating rinses high in chromium, also contains copper, nickel and cyanide

TABLE 4-3 (CONT'D)

Industry	Type	Volume (gpd)	Disposal	Character of Wastes
Rauscher Plating Company Limited	plating	30,000	Grand River	plating rinses high in cyanide and zinc, some nickel, cadmium, copper, chromium
Royal Metal Manufacturing Company Limited	manufacturing (metal finishing)	50,000	storm sewer	plating rinses contain some nickel, chromium and zinc

TABLE 4-4

SAMPLE RESULTS - MUNICIPAL AND INDUSTRIAL WASTE EFFLUENTS

CITY OF GALT

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
G 91.1I	5.11.65	South Waterloo Memorial Hospital	2.0	782	30	0
G 90.6W	5.11.65	Wright Ave.	5.2	494	10	200
G 90.2W	5.11.65	Samuelson St.	2.6	470	9	400
G 89.3W	5.11.65	River St.	14.0	2,320	15	26,100,000
G 89.2W2	5.27.65	St. Andrew's St.	4.6	866	44	320
G 89.2I	5.11.65	Dixon Dairy Products Limited	720	1,292	274	19,000
G 89.2W1	5.27.65	Malcom St.	4.8	1,086	48	2,400
G 89.1W	5.27.65	Cedar St.	1.6	576	1	7,900
GG 89.8W	5.11.65	Kerr St. East Side	1.2	578	3	250

TABLE 4-4 (CONT'D)

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GG 90.1W1	5.11.65	Dundas St. North-west Side	4.3	428	3	14,000
GG 90.4W	5.11.65	Elgin St.	1.1	334	2	9,000

TABLE 4-5

CITY OF GALT - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Anionic Detergents as ABS (ppm)	Phosphates as PO_4 (ppm)	MF Coliform Count/100 ml	Phenols (ppb)
				AT GALT DAM					
G 89.8	4.19.61	1.5	274		6			0	
	8.23.61	1.7	336		3			150,000	
	5.18.62	14	356		21			90,000	4
	10.10.62	5.8	426		-			11,000	
	2.14.63	5.6	500		5.5			6,900	
	10. 9.63	2.2	366		2.3			580	
	12.16.63	3.2	486	3		0.5	1.0	4,300	
	12.17.63	4.6	482	6		0.5	1.30	3,100	
	12.18.63	4.8	470	3		0.4	1.28	5,500	
	2.20.64	4.2	492	1		0.4	1.5	2,100	15
	2.22.64	2.5	464	4		0.4	1.4	610	
	2.10.64	2.9	456		1.8	0.3	0.86	1,500	
	2.12.64	5.1	494		1.8	0.4	1.0		4
Average		4.5	430	3	6.0	0.4	1.19		
				AT RIVERSIDE BRIDGE					
G 86.5	5.19.61	5.2	280		6			10	
	2.14.63	8.8	484		4.5			6,700	
	8.23.63	1.5	336		2			57,000	

TABLE 4-5 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Anionic Detergents as ABS (ppm)	Phosphates as PO_4 (ppm)	MF Coliform Count/100 ml	Phenols (ppb)
G 86.5	10.10.63	2.4	382		1.7			6,000	
	12.16.63	5.2	492	7		0.5	1.22	5,700	
	12.17.63	6.6	486	6		0.4	1.54	3,700	
	12.18.63	5.1	456	5		0.3	1.52	4,500	
	2.20.64	9.2	504	10		0.7	2.00		12
	2.22.64	4.2	488	6		0.3	1.24	460	
	2.10.64	3.7	454			0.2	0.80	70	
	2.12.64	4.4	480		1.8	0.3	0.96	1,800	0
	7.20.64	3.5	390	26	23			240	28
	8.31.64	2.0	374	24				570	23
	10. 5.64	2.4	368	7	8.5			11,000	
	12.15.64	7.4	374	23	18			15,000	0.5
	1.26.65	2.8	456	6	2.5			1,200	0.5
	2.22.65	2.7	364	8	2.6			1,800	
Average		4.5	422	11	7.1	0.4	1.33		

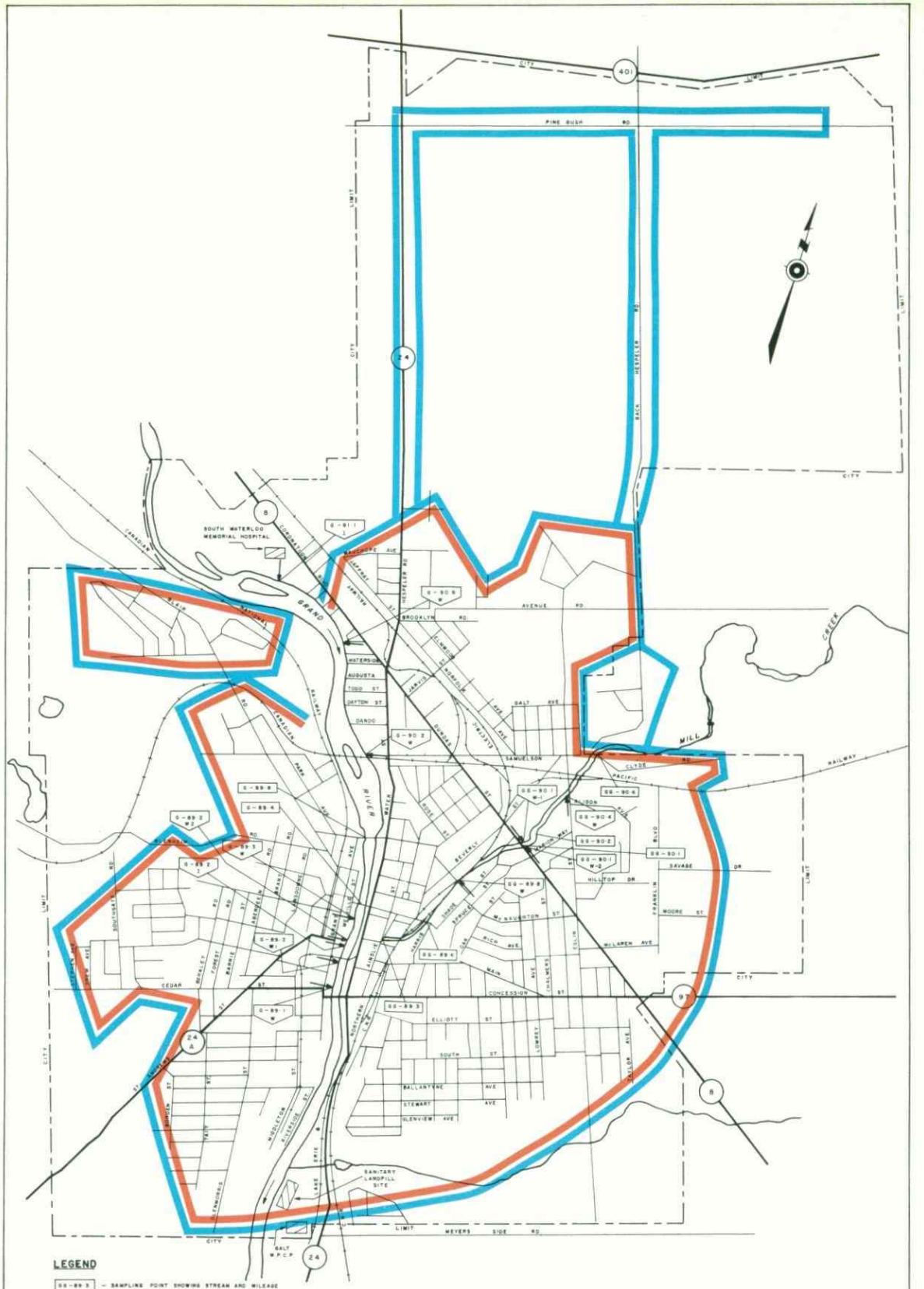
TABLE 4-6

CITY OF GALT - SAMPLE RESULTS - MILL CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
			AT MOUTH			
GG 89.3	2.16.61	2.9	332		3	190
	8.23.61	0.9	334		1	540
			AT MAIN STREET			
GG 89.6	2.16.61	4.0	294			50
	8.23.61	0.9	340		1	40
			AT DUNDAS STREET			
GG 90.1	2.16.61	2.4	296		2	5
	8.23.61	0.5	338		1	80
	10.20.61	1.8			1	26
			AT SOPER PARK - (KINSMEN POOL)			
GG 90.2	7. 5.63	1.4	314		1.7	64
	7.29.63					19,000
	9.10.63					360
	9.10.63					200

TABLE 4-6 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
			AT CLYDE RD.			
GG 90.6	7. 5.63	1.4	308		1.7	3,000
	7.28.63					17,000
	9.10.63					90
	9.10.63					130
			AT BASE LINE RD.			
GG 94.2	7. 5.63	1.1	292		1.5	78



LEGEND

- 88-89 3 – SAMPLING POINT SHOWING STREAM AND MILEAGE
- S-89 1 W – OUTFALL SHOWING STREAM AND MILEAGE – TYPE OF OUTFALL
  - I – INDUSTRIAL WASTE
  - W – STORM SEWER
- BOUNDARY OF WATER AREA
- BOUNDARY OF SEWER AREA

ONTARIO WATER RESOURCES COMMISSION

CITY OF GALT
FIGURE 4-1

SCALE 500 0 500 1000 1500 2000 FEET	
DRAWN BY L.L.B.	DATE JUNE, 1965
CHECKED BY: A.C.	DRAWING No: 65-78

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CHAPTER 5

CITY OF KITCHENER

I GENERAL

The City of Kitchener, the county's largest municipality and the county seat, is located in the south-central portion of the county. Drainage of the city is to the Grand River either directly or via its tributary, Schneider Creek.

Many varied industries are located in the city, making it Canada's most highly industrialized city on the basis of per capita value of production. It is a centre for governmental services, as well as for insurance, investment and financial institutions.

The 1964 assessed population was 82,674.

II WATER SUPPLY

1. Municipal

(a) Sources

Water is obtained from 23 wells. Details of these wells are given in Table 5-1. All wells except No.15 draw water from the overburden. The wells are grouped into five main fields as follows:

1. The Shoemaker well field, located in the southwest section of the city, contains wells 1 to 6, inclusive. The rated yield of this well field is approximately 3.8 mgd.

2. The Strange Street well field, located in the northwest section of the city, contains wells 10 to 17, inclusive. The rated yield of this well field is approximately 2.8 mgd. Wells 11 and 13 act in sympathy and are, therefore, only pumped together for short periods when necessary. Well 15 is used to add water to Victoria Park Lake and only pumps into the system during emergencies.

3. The Mannheim well field, located to the west of the city, contains wells 21 to 25, inclusive. The rated yield of this well field is approximately 5.6 mgd.

4. The Parkway well field, located in the southern section

of the city, consists of wells 31 and 32. The rated yield of this well field is approximately 2.0 mgd.

5. The Lancaster well field, located in the northern section of the city, contains wells 41 and 42. The combined rated yield of these wells is 0.65 mgd, but well 42 normally is not used because of the high iron content in the water. The combined yield of the well fields is 14.5 mgd.

All of the wells are equipped with electrically driven, deep-well, vertical centrifugal pumps. Until recently the Shoemaker and Mannheim wells were controlled from the Shoemaker plant, and the Strange Street and northern wells were controlled from the Strange Street plant. The wells are now controlled from the new plant in the Shoemaker well field. Two generators driven by diesel motors are maintained in case of a power failure. These generators are located at the Shoemaker and Strange Street plants.

(b) Treatment

No treatment is provided the city water on a municipal basis. Many of the consumers have individual water-softening units.

(c) Water Pumpage

The average daily water pumpage in the city has shown an overall increase of approximately 9 per cent from 1960 to 1964. The per capita pumpage, however, has remained essentially unchanged during that time, averaging approximately 100 gpd. A summary of water pumpages for the period 1960 to 1964 is shown below;

	Pumpage			
Year	Total (mg)	Avg. Day (mg)	Max. Day (mg)	Per Capita (gpd)
1960	2,752.3	7.52	11.83	103
1961	2,591.5	7.10	-	95
1962	2,828.1	7.75	12.09	100
1963	2,844.2	7.79	13.64	97
1964	2,998.7	8.19	12.84	99

It is noted from the above figures that the maximum pumpage to date has been 13.64 mgd, approaching the present 14.5-mgd estimated yield of the existing wells and well fields.

(d) Water Quality

The quality of the water from all wells in the Kitchener system is of generally satisfactory chemical quality. The water from all wells, however, is hard and 8 of the 21 wells presently in regular use exhibit an average iron content in excess of the recommended upper limit of 0.3 ppm. None of the wells has a fluoride content which could be considered effective in the prevention of dental caries.

A summary of the analyses of samples collected for chemical-quality determination from 1961 to 1964 inclusive is shown in Table 5-2. The quality of the water in each of the wells has shown little variation in quality over the sampling period. For this reason the summary contains only average values.

The bacteriological quality of the water has been satisfactory in the past.

(e) Distribution and Storage

Water is distributed through approximately 203 miles of mains ranging in size from 2 to 30 inches. There are approximately 18,000 domestic, 900 commercial and 230 industrial services. The system is totally metered.

The city supplies water to approximately 2,100 residents in the Village of Bridgeport, the City of Waterloo and the Township of Waterloo.

A total of approximately 16 mg of distribution-system storage is provided. This is provided by one 5-mg, high-elevation, ground-level reservoir; five ground-level reservoirs with capacities of 1.0 mg, 1.0 mg, 2.0 mg, 2.5 mg and 3.0 mg; and two elevated towers with capacities of 0.5 and 0.9 mg.

2. Potential Additional Supplies

(a) Ground Water

In order to locate additional ground-water supplies the City of Kitchener has been carrying out an extensive program of test drilling. A ground-water survey was carried out for the city by the Ontario Water Resources Commission in 1963. The subsequent report indicated that additional supplies of ground water may be available from the overburden aquifers west of Mannheim and in the Breslau area and from the bedrock east of the Grand River. The quality of water from the

Petersburg area, northwest of Mannheim, should be the best in the Kitchener-Waterloo area, whereas water from other overburden aquifers and the bedrock east of the Grand River probably has a high iron content and may require treatment.

The report also suggested the possibility of obtaining a supply of water from the Grand River by means of infiltration systems. The application of this method is under study at the present time.

(b) Surface Water

The Grand River could provide additional water for the city's municipal water supply; however, this water would require extensive treatment to make it suitable for this purpose. Intake locations should be carefully considered in terms of known and potential sources of contamination.

The feasibility of having a co-ordinated program for water supply and treatment for the municipalities in the County of Waterloo and adjacent counties should be investigated. Pipeline studies considering the Grand River or one of the Great Lakes as a source for supply would have to be conducted to determine the most suitable solution to the water-supply problem.

3. Future Requirements

The per capita pumpage over the past 5 years has averaged approximately 100 gpd, while maximum per capita pumpages have been as high as 175 gpd. The foregoing figures and the present capacity of the well fields now in use suggest that a population only slightly more than the present population can be adequately served by the present supply. The very large distribution-system storage, however, will enable the system to meet significantly larger demands for short-term periods.

The city is engaged in a continuing exploration program to obtain additional sources of water to augment the present supply. To date the ground-water exploration program has resulted in the city's being able to obtain sufficient quantities to meet current demands. Also, the city has been engaged in a 4-year sampling program of the Grand River at Bridgeport to determine its suitability as a future water-supply source. Preliminary conclusions based on the results of the program indicate that the water would require extensive treatment to make it suitable for municipal use.

III WATER POLLUTION

1. Pollution Control Facilities

General

Domestic and industrial wastes from the city are treated in an activated-sludge-type water pollution control plant. The design capacity of the plant is 13.5 mgd based on an ultimate contributory population of 100,000. The plant was constructed under joint agreement between the city and the OWRC. The full secondary treatment facilities were completed in 1963.

Treatment consists of coarse screening, shredding, grit removal, fine screening, primary sedimentation, mechanical aeration, final sedimentation, chlorination of the effluent, two-stage sludge digestion and sludge vacuum filtration. The plant effluent is discharged directly to the Grand River.

Sanitary services are provided for all developed areas of the city. A portion of the Village of Bridgeport is served by sewers which discharge to the Kitchener system.

Treatment Efficiency

A summary of the analyses of samples of the raw sewage and final effluent, and the corresponding plant efficiencies related to these analyses, is shown below:

		5-Day BOD				Suspended Solids			
Year	No. of Samples	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1961*	12								
Raw Sewage		288	310	265		269	316	226	
Final Effluent		172	205	160	40	159	168	140	41
1962*	50								
Raw Sewage		306	1000	145		288	591	104	
Final Effluent		197	265	120	36	153	272	94	47
1963* (Jan. to Aug.)	25								
Raw Sewage		268	510	150		283	393	138	
Final Effluent		194	260	112	28	153	205	105	46

Year	No. of Samples	5-Day BOD Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Suspended Solids Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1963** (Sept. to Dec.)	7								
Raw Sewage		363	450	270		370	445	345	
Final Effluent		23	38	14	94	21	26	13	94
1964	15								
Raw Sewage		433	1140	270		401	576	288	
Final Effluent		19	45	4	96	20	40	4	95

* primary treatment only
** commencement of secondary treatment

The foregoing figures suggest that satisfactory treatment has been achieved during the time that the plant has been providing full secondary treatment. Plants of this type are normally expected to obtain reductions of 90 to 95 per cent in BOD and suspended solids.

Sewage Flows

A summary of sewage flows recorded at the plant to the end of 1964 is shown below:

	1961*	1962	1963	1964
Total Flow (mg)	2,641.56	3,255.35	2,841.14	3,026.52
Average Flow (mgd)	8.07	8.92	7.78	8.27
Maximum Flow (mgd)	15.53	14.10	11.13	12.41
Average Per Capita (gpd)	108	116	97	100
Sewage Flow to Water Consumption Ratio	1.14	1.15	1.00	1.01

* from February 7 to December 31

The average daily flow at the Kitchener plant is well below the 13.5-mgd design flow. The average sewage flow is very close to the average water consumption, and the per capita sewage flow appears to be reducing. The plant was designed on the basis of 135 gpcpd so that ultimately the plant may be able to accommodate more than the 100,000 design population.

2. Industrial Waste Disposal

The City of Kitchener has over 200 industries which

discharge wastes to the city's sanitary sewers. Twenty-three of the industries which are considered to have significant waste discharges are summarized in Table 5-3.

The industries contribute an estimated 60 per cent of the organic loading and 40 per cent of the hydraulic loading to the water pollution control plant. This is due to the discharge of wastes high in organic content by industries such as dairies, meat packers, food processers and tanneries, and the discharge of large volumes of relatively clean cooling water by the rubber industries. It is estimated that the meat-packing and tannery wastes constitute 90 per cent of the industrial waste loading, based on BOD and suspended solids.

Wastes from the plating industries do not contain organic constituents. However, their wastes could, in extreme cases, cause operating problems with the biological treatment process at the pollution control plant due to the toxic effect of the heavy metal ions, such as copper, nickel, chromium, etc., and pH changes.

While the major industrial waste discharges are to the sanitary sewers, there remain a few problems of waste disposal by other means. Currently under investigation are:

1. the discharge of sawdust to a storm drain
2. metal-finishing wastes to a creek
3. packinghouse wastes to a storm sewer

3. Refuse Disposal

The municipal sanitary landfill site is located on a 118-acre area in the southwestern part of the city on Strasburg Road south of Ottawa Street. The relatively impermeable soil should prevent any contamination of the deep gravel aquifer. There are no surface streams leading from the disposal property.

4. Surface-Water Quality

Sample results obtained from waste effluents and from those parts of the Grand River and Schneider Creek that are within the city are shown in tables 5-4, 5-5 and 5-6

The chemical and bacteriological analyses of samples taken from the storm sewer that discharges to Schneider Creek at Kent Ave. indicate the presence of domestic sewage. It is

reported that this sewer receives domestic wastewater from residences in the older section of the city.

There were numerous other outfalls located, but they were not included owing to the absence of any discharge.

Schneider Creek is enclosed from Victoria Park at David Street to a point immediately south of Peter Street, a distance of approximately 2,200 feet. There are reportedly a number of private outfalls from residential and commercial establishments that discharge raw waste to the creek in this covered region. As a result of these discharges, deterioration of the water quality in Schneider Creek is evident as it flows through the city.

The locations of storm sewer outlets and stream sampling points are shown on Figure 5-1.

5. Future Requirements

The water pollution control facilities are adequate to handle the present and at least medium-term population growths, possibly up to the next 10 years. If the large volumes of cooling water which are discharged from some of the industries were separated from the sanitary flow the life expectancy of the plant would be increased.

Waste-disposal facilities will be required at those industries which presently discharge wastes untreated to natural watercourses. It may be possible to accept these wastes into the sanitary sewer system, although some may require pre-treatment at the industry.

IV CONCLUSIONS

1. Water Supply

The chemical and bacteriological qualities of the present water supply are satisfactory.

The present available quantity is adequate to serve the city's present and short-term future needs. However, additional future sources will be required. A portion of these may be obtainable from ground-water sources relatively close to the city but ultimately the economical development of these sources will be reached.

Surface-water sources may have to be relied on to complete the future municipal requirements. In this regard, it would

be more advisable to consider a supply from the Great Lakes in co-operation with other municipalities in the area rather than attempt to use water from the Grand River.

2. Pollution Control

Although the city's pollution control program is well developed there remain a few sources of pollution. Pollution of natural watercourses in the city continues as a result of a few domestic and industrial waste discharges.

The water pollution control plant has sufficient capacity available to meet the present and medium-term future needs.

There is no pollution problem arising from the operation of the city's sanitary landfill.

TABLE 5-1

CITY OF KITCHENER - WELL DATA

Well	Name	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Screen Length (ft)	Rated Capacity (gpm)	Yield of Well or Field (mgd)	Remarks
	Shoemaker Field							3.8	
1	Nearest Peerless		158	18	Overburden	20	620		
2	Farthest Peerless		159	18	Overburden		490		
3	2A		170	12	Overburden		210		
4	No.1 Layne	1935	141	26	Overburden	50	980		
5	No.2 Layne	1947	128	12	Overburden	20	830		
6	6A		177	12	Overburden		140		
	Strange Field							2.8	
10	Prokop	1935	72	18	Overburden	20	310		
11	Front Bauer	1942	115	14	Overburden	15	700		well capacity when well No.13 not pumped
12	Glasgow Street	1945	165	10	Overburden	30	210		

TABLE 5-1 (CONT'D)

Well	Name	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Screen Length (ft)	Rated Capacity (gpm)	Yield of Well or Field (mgd)	Remarks
13	Rear Bauer	1946	108	14	Overburden	10	700		well capacity when well No.11 not pumped
14	Metzloff	1947	189	10	Overburden	10	200		
15	No.1 Rock Well		300	8	Bedrock		260		not used because of the high iron content in the water
16	No.6	1939	80	12	Overburden	17	330		
17	Kelly		100		Overburden		210		
	Mannheim Field							5.6	
21	Mannheim 1-Feick	1953	190	18	Overburden	20	1000		
22	Mannheim 2-Erb	1954	86	18	Overburden	15	1000		
23	Mannheim 3-Bowman	1950	86	18	Overburden	10	690		
24	Mannheim 4-Devitt	1956	110	18	Overburden	15	690		
25	Mannheim 5	1962	164	16	Overburden		410		

TABLE 5-1 (CONT'D)

Well	Name	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Screen Length (ft)	Rated Capacity (gpm)	Yield of Well or Field (gpd)	Remarks
	Parkway Field							2.0	
31	Parkway 1	1958	109	16	Overburden		690		
32	Parkway 2	1960		16	Overburden		690		
	Lancaster Field							0.3	
41	Guelph Street	1936	116	14	Overburden	15	200		
42	Lockart	1945	157	10	Overburden	10	310		not used because of the high iron content in the water
								14.5	

TABLE 5-2

CITY OF KITCHENER - CHEMICAL WATER QUALITY

Well		Well**** Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Shoemaker	1	K-1	5	368	263	0.07	13	7.5	0.2***
	2	K-2	5	430	208	0.14	5	7.6	0.3***
	3	K-3	5	371	281	0.17	12	7.6	0.1***
	4	K-4	4	456	287	0.46	19	7.7	0.2***
	5	K-5	4	415	297	0.14	25	7.6	Trace***
	6	K-6	4	350	236	0.38	4	7.7	0.2***
Strange	10	K-10	3	429	267	0.30	12	7.5	0.0**
	11	K-11	3	303	216	0.12	11	7.7	0.1**
	12	K-12	3	377	255	0.12	24	7.7	0.2**
	13	K-13	4	292	250	0.61	9	7.8	Trace***
	14	K-14	4	287	237	0.33	13	7.8	0.3*
	16	K-16	4	541	326	0.10	200	7.3	0.1***
	17	K-17	4	429	272	0.11	119	7.5	0.2**
Mannheim	21	K-21	4	275	255	0.14	4	7.7	0.1***
	22	K-22	5	299	249	0.56	8	7.7	Trace***
	23	K-23	5	283	247	0.15	8	7.8	0.1***
	24	K-24	4	262	227	0.11	6	7.9	0.1**
	25	K-25	1	276	236	0.18	5	7.7	0.1
Parkway	31	K-31	2	264	231	0.85	18	7.8	0.0*
	32	K-32	2	287	232	1.23	17	7.8	0.1*
Lancaster	41	K-41	3	406	209	0.61	7	7.8	0.2

* one sample ** two samples
*** three samples **** refers to well shown on Figure 3-2

TABLE 5-3

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES TO SANITARY SEWER SYSTEM

CITY OF KITCHENER

Industry	Type	Volume	Characteristics
Kitchener Dairies Limited	dairy	47,000	dairy wastes contribute BOD from spills of milk or milk products as well as from wash-up operations
Maple Lane Dairy	dairy	19,000	
Silverwood Dairies Limited	dairy	63,000	
Westside Dairy	dairy	35,000	
Burns and Co. (Eastern) Limited	meat packing	151,000	meat-packing wastes contain high concentrations of BOD and suspended solids. Fat can also be a problem
Kitchener Packers Limited	meat packing	18,000	
Schneider Limited	meat packing	650,000	
Hoffman and Sons	meat packing	18,000	
Canada Skate Manufacturing Co.	manufacturing (plating)	17,000	plating rinses contain chromium, nickel, copper, zinc and cyanide
Globe Stamping Co. Limited	manufacturing (plating)	100,000	plating rinses contain very low concentrations of cyanide and chromium

TABLE 5-3 (CONT'D)

Industry	Type	Volume (gpd)	Characteristics
Kuntz Electroplaters	plating	84,000	plating rinses contain copper, nickel, chromium, cadmium, zinc and cyanide
Dominion Rubber Company			
Foam and Footwear	rubber mfg.	150,000	rubber manufacturing wastes are mainly cooling water containing low concentrations of suspended solids
Tire Plant	rubber mfg.	975,000	
B. F. Goodrich Canada Limited	rubber mfg.	364,000	
Kaufman Rubber Company	rubber mfg.	140,000	
Dominion Rubber Company	textile	100,000	textile wastes contain BOD and suspended solids in concentrations equivalent to sanitary sewage
Rumple Felt Company Limited	textile	20,000	
Ontario Tanning	tannery	4,000	tannery wastes contain very high concentrations of BOD and suspended solids
John A. Lang and Sons Limited	tannery	420,000	

TABLE 5-4

CITY OF KITCHENER - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENTS

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml	Phenols (ppb)
GS 104.7W1	11.8.65	Victoria St. Storm Sewer at Schneider Creek	0.6	1,740	3	610	
GS 104.7W2	11.8.65	Storm Sewer from Ball Park	2.2	780	5	19,000	
GS 104.7W3	11.8.65	David St.	1.0	1,740	2		
GS 103.4W	12.2.64	Kent Ave.	84	1,048	82	270,000	200
	28.2.64		4.4	904	4	107,000	4
	13.5.64		5.6	454	12	97,000	

TABLE 5-5

CITY OF KITCHENER - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			AT PIONEER TOWER DOWNSTREAM FROM KITCHENER WPCP				
G 97.7	7.31.62	5.0	264		4.5		
	2.12.63	26	586		31	150,000	
	6. 6.63					53,000	
	10. 9.63	6.4	592	83		3,900	
Average		12.5	461				
			AT FREEPORT BRIDGE				
G101.0	7.19.60	3.8	204		13	2,270	
	4.19.61	3.8	262		5	0	
	8.23.61	1.1	298		3	300	
	5.18.62	2.8	244		1.8		3
	7.31.62	3.2	258		7.5		
	10.10.62	3.2	398		0	1,290	
	2.14.63	5.0	418		6.0	32,000	
	6. 6.63					1,700	
	10. 9.63	2.3	280		2.8	1,060	
Average		3.0	295		4.9		

TABLE 5-6

CITY OF KITCHENER - SAMPLE RESULTS - SCHNEIDER CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
AT WATERLOO TOWNSHIP RD. NO. 4 (PIONEER VILLAGE)							
GS 99.1	2.28.64	5.1	1,500	24		1,410	10
	6. 8.64	5.0	586	21		250	
	10. 7.64	3.2	842	1		49,000	
	5.13.65	4.4	630	8	8.1	190,000	
Average		4.4	889	19			
AT BALZER RD.							
GS 101.0	2.12.64	12.0	848	26		3,100	12
	2.28.64	8.0	1,126	6		3,900	15
	10. 7.64	2.9	780	10		29,000	9
Average		7.6	921	14			12

TABLE 5-6 (CONT'D)

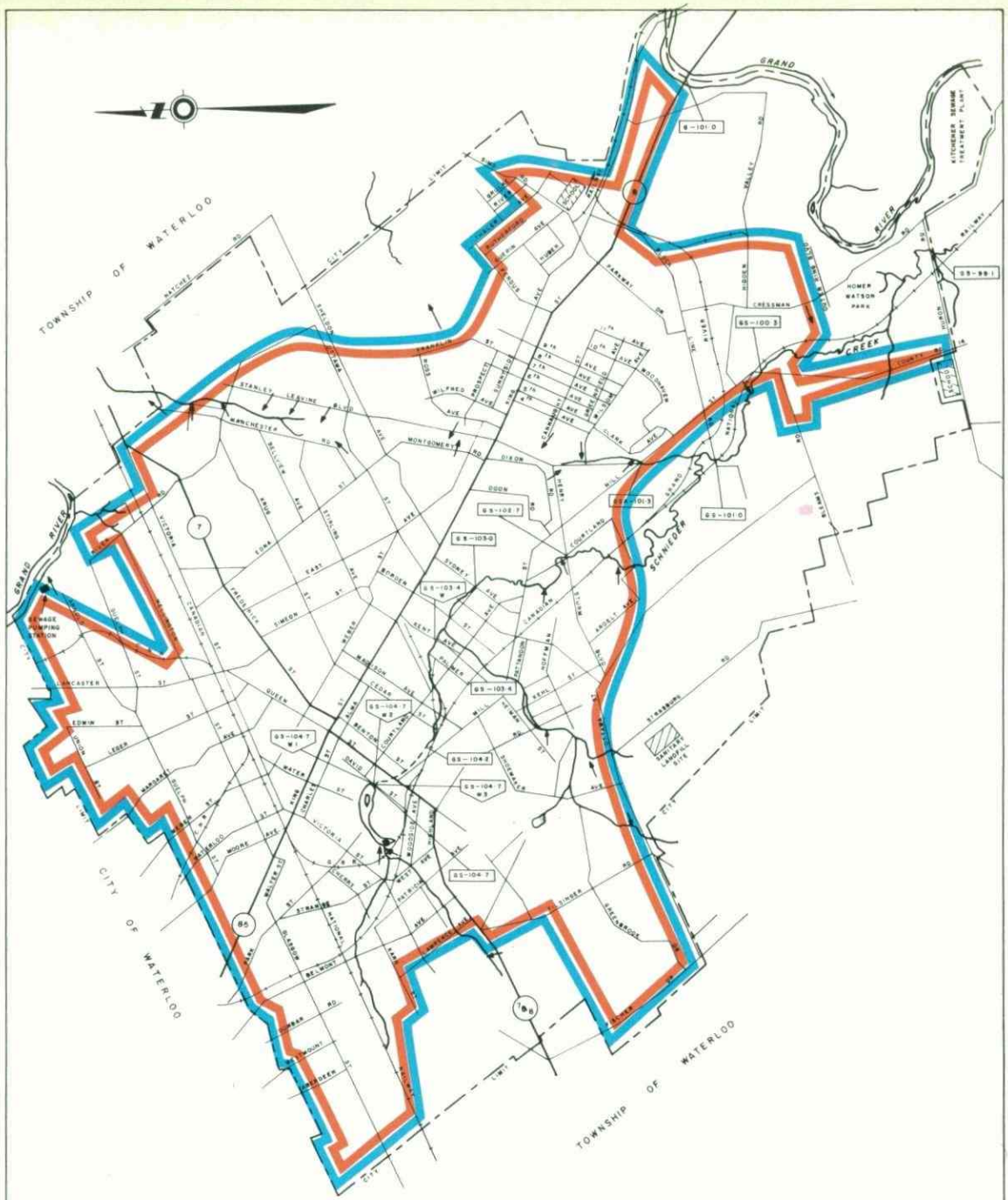
Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			AT HENRY STURM BLVD				
GS102.7	2.12.64	5.4	874	96		57,000	15
	2.28.64	4.9	960	5		8,100	6
	10. 7.64	8.4	680	3		23,000	5
	5.13.65	62	656	24	7.3	30,000	
Average		20.2	792	32			8
			BRANCH NO.1 AT MILL ST.				
GSA101.3	10. 7.64	1.3	564	4		730	4
	5.13.65	1.1	542	8		1,500	
Average		1.2	553	6			
			AT SYDNEY ST.				
GS103.0	7.19.60	3.3	584	26		27,000	
	8. 3.61	2.0	692		2	8,300	
	2.12.64	5.9	1,052			14,000	18
	2.28.64	14.0	754	2		35,000	8
	10. 7.64	6.0	1,128	2		51,000	10
Average		6.2	842	10			12

TABLE 5-6 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			AT KENT AVE.				
GS103.4	2.12.64	8.2	1,108	16		53,000	23
	2.28.64	48.0	1,218	176		11,200	60
	10. 7.64	2.2	1,538	5		141,000	8
	5.13.65	1.4	1,132	10		15,000	
Average		14.9	999	52			30
			AT CULVERT OUTLET SOUTH OF PETER ST.				
GS104.2	2.12.64	13	1,190	14		100,000	50
	2.28.64	14	1,258	13		24,300	20
	10. 7.64	12	916	15		78,000	20
	5.13.65	4.4	826	7		41,000	
Average		10.9	1,050	12			30
			AT DAVID ST. VICTORIA PARK				
GS104.7	2.12.64	3.4	724			60	7
	2.28.64	11	1,746	5		20	25
	10. 7.64		NO FLOW				
	5.13.65	1.2	550	3		3,100	
Average		5.2	1,006	4			16

TABLE 5-6 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
AT DAVID ST. 20 FT DOWNSTREAM FROM STORM SEWER OUTFALLS							
GS104.7	8.11.65	1.6	860	7		17,000	



LEGEND

65-104-7 – SAMPLING POINT SHOWING STREAM AND MILEAGE

65-103-6 W – OUTFALL SHOWING STREAM AND MILEAGE – TYPE OF OUTFALL

W – STORM SEWER

– BOUNDARY OF WATER AREA

– BOUNDARY OF SEWER AREA

– STORM SEWER OUTFALL (NO FLOW)

ONTARIO WATER RESOURCES COMMISSION

CITY OF KITCHENER

FIGURE 5-1

SCALE : 2000 0 2000 FEET	
DRAWN BY L.L.B	DATE JULY, 1965
CHECKED BY A.C.	DRAWING No. 65-92

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CHAPTER 6

CITY OF WATERLOO

I GENERAL

The City of Waterloo is centrally located in the county. Drainage of the city is to the Grand River, either directly or through its tributary, Laurel Creek.

The city is highly industrialized with many new industries having built plants in the industrial park area. Waterloo is also a centre for commerce and finance and has one of Canada's largest engineering schools in the University of Waterloo.

The 1964 assessed population was 25,478.

II WATER SUPPLY

1. Municipal

(a) Source

The City of Waterloo obtains its water supply from six drilled wells. Details of these wells are given in Table 6-1.

Wells 1, 2 and 3 are located at the William Street pumping station in the central section of the city. Wells 1 and 2 are pumped alternately since they are close together and receive water from the same aquifer. Well 3 is the only rock well in the system and is used only when necessary, because of the unsatisfactory chemical quality of the water.

Well 4 is located on the University of Waterloo grounds. It is operated almost continuously and normally provides sufficient water for use during the night.

Well 5 is located northwest of the city and well 6 is located approximately 2 miles west, in what is now called the St. Agatha well field.

The total yield of the six wells is 4.53 mgd; however, excluding the yield of well 3, the total yield of good-quality water is 3.88 mgd.

(b) Treatment

No treatment of city water is provided on a municipal

basis, but many users have individual water-softening units. The Public Utilities Commission plans to install chemical feed equipment at the Shantz well in 1965 to control problems associated with the presence of iron in the water.

(c) Water Pumpage

A summary of water pumpage figures for the period 1960 to 1964 is shown below:

Year	Pumpage Total (mg)	Pumpage Avg. Day (mg)	Pumpage Max. Day (mg)	Per Capita (gpd)
1960	663.383	1.810	2.704	88
1961	631.831	1.731	3.175	80
1962	786.644	2.150	3.861	96
1963	740.533	2.040	-	87
1964	802.676	2.193	3.825	86

The average daily pumpage of water for the city has shown an approximate increase of 21 per cent from 1960 to 1964 inclusive. The per capita consumption has remained fairly constant at about 90 gpd.

(d) Water Quality

The results of the analyses of samples collected from the city's wells for the period 1960 to 1964 inclusive are shown in Table 6-2. The variation in quality of the water from each of the wells has not been significant and for this reason only average values are shown.

The results indicate that the water from all wells is very hard, and only two of the wells exhibit iron concentrations below the recommended upper limit of 0.3 ppm. Problems with the high iron content in the Shantz well have led to the city's plans to provide chemical feed equipment for its control. William Street No.3 is the only well to exhibit a fluoride content considered beneficial in the control of dental caries.

The bacteriological quality of the water has been satisfactory.

(e) Distribution and Storage

The distribution system contains approximately 64 miles of water mains ranging in size from 2 to 18 inches. The system is totally metered and has approximately 4,900 domestic,

310 commercial and 160 industrial services.

Storage is provided by three 0.25-mg reservoirs, one 0.5-mg reservoir and one 0.25-mg standpipe.

2. Private Water Works

Colonial Acres Subdivision

The Colonial Acres subdivision is located in the northeast portion of the city. The subdivision was located in an area of the Township of Waterloo which was annexed by the city in January 1965.

The water works system presently serves approximately 25 homes but will ultimately serve approximately 63. Water is obtained from a 186-foot-deep, overburden well with an 8-inch-diameter casing. The well has an 11-foot, 25-slot screen. The rated capacity of the well is 270 gpm.

The water is pumped from the well to a pressure tank. From the tank the water passes through an ion-exchange unit which effects both water softening and iron removal.

Water Quality

The chemical quality of the raw water from this source is generally unsatisfactory. It is very hard and has an iron content well in excess of the recommended upper limit of 0.3 ppm. Since the installation of the ion-exchange unit the chemical quality of the water entering the distribution system has been generally satisfactory. A summary of the analyses of raw- and treated-water samples is shown in Table 6-3.

The bacteriological quality of the water has been satisfactory.

3. Potential Additional Supplies

(a) Ground Water

The City of Waterloo has carried out a considerable amount of test drilling to the west of its boundaries near St. Agatha. As a result of this test drilling, additional ground-water supplies were located and it was possible to construct well 6. Two other test holes, 7-57 and 7A-57, were drilled approximately 3,000 feet southeast of well 6. It was reported that 1 mgd should be available from each of these locations if permanent large-diameter wells were constructed.

If permanent wells were constructed at these locations the total yield of good-quality ground water for the city would be almost 6 mgd.

Information which is presently available indicates that it may be possible to locate additional overburden wells up to 3 miles west of well 6 and north of this area towards Erbsville and also in a restricted area approximately 1 mile northeast of the present city limits. There are a number of good rock wells north of the city; however, the chemical quality of the water from any large-capacity well constructed in that area would probably be similar to that from well 3.

(b) Surface Water

The Grand River could provide additional water for the city's municipal water supply; however, this water would require extensive treatment to make it suitable for this purpose. Intake locations would have to be carefully considered in terms of known and potential sources of contamination.

The feasibility of having a co-ordinated program for water supply and treatment for the municipalities in the County of Waterloo and adjacent counties should be investigated. Pipeline studies considering the Grand River or one of the Great Lakes as a source for supply would have to be conducted to determine the most suitable solution to the water-supply problem.

4. Future Requirements

Average per capita water pumpages in the past have been as high as 100 gpd, while maximum per capita pumpages have been as high as 175 gpd. The total yield of the present well fields, and of known well fields not yet developed, is approximately 6 mgd. This available quantity indicates that a population of approximately 34,000 can be adequately supplied during maximum-demand periods. According to the population projection figures presented in Chapter 2 this population will be realized about 1969.

III WATER POLLUTION

1. Pollution Control Facilities

General

The City of Waterloo provides full secondary treatment

to domestic and industrial wastes from virtually the entire developed area of the city. Only a few of the older areas, and some recently annexed, are served by individual septic tank systems. These areas are estimated to constitute less than 2 per cent of the city's total population.

Treatment is provided in a 4-mgd activated-sludge-type water pollution control plant. The treatment process consists of coarse screening, shredding, grit removal, primary sedimentation, aeration, final sedimentation, chlorination of the effluent and raw-sludge vacuum filtration. The effluent is discharged to the Grand River.

The plant was constructed under joint agreement between the city and the OWRC and was placed in operation in 1961.

Treatment Efficiency

A summary of the analyses of samples of the raw sewage and final effluent, and the corresponding plant efficiencies related to these analyses, is shown below:

		5-Day BOD				Suspended Solids			
Year	No. of Samples	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1961	33								
Raw Sewage		589	1380	290		337	2710	160	
Final Effluent		67	350	10	89	123	804	40	64
1962	52								
Raw Sewage		720	1545	310		517	1210	195	
Final Effluent		108	315	9	85	81	207	15	84
1963	33								
Raw Sewage		843	3400	220		541	940	216	
Final Effluent		98	440	13	88	54	124	9	90
1964	32								
Raw Sewage		661	1220	185		513	1152	86	
Final Effluent		104	570	7	84	97	602	10	81

The operating efficiency is, on the average, below that expected from this type of plant. However, the plant has received wastes with organic strengths two to three times that normally expected and with pH values varying over a wide range, due to caustic and acidic wastes discharged by major industries. These abnormalities have resulted in periodic

upset of the biological process and a general lowering of the efficiency.

Extensive waste-loading and industrial in-plant studies have recently been completed by the OWRC. The results of these studies will be incorporated into a consulting engineer's report on recommendations for improved treatment. Improvements may be in the form of industrial in-plant pre-treatment, extension of existing treatment plant facilities or a combination of the two.

Sewage Flows

A summary of the average flows recorded at the Waterloo plant to the end of 1964 is shown below:

	1961	1962	1963	1964
Total Flow (mg)	599.373	736.953	762.446	852.937
Average Flow (mgd)	1.642	2.019	2.089	2.330
Maximum Flow (mgd)	3.778	3.130	3.777	3.728
Average Per Capita (gpd)	76	91	89	91
Sewage Flow to Water Consumption Ratio	0.95	0.94	1.02	1.06

The foregoing figures suggest that on the average, the flow received at the plant is well below the design flow of 4.0 mgd. Also, the average daily per capita flow is well below the design flow of 200 gpd.

2. Industrial Waste Disposal

Seven of the 20 industries whose waste-disposal practices were investigated, were found to discharge significant amounts of industrial wastes. Wastes from the seven "wet" industries may be divided into metal-finishing wastes and organic-type wastes. A brief description of these industries is provided in Table 6-4.

Wastes from the metal-finishing industries originate in processes such as plating, pickling, and preparing surfaces for pointing and painting. The main constituents of these wastes are heavy metal ions and cyanide. These industries also have batch discharges of acids and alkaline solutions used for the surface treatment of metals.

Organic-type wastes are discharged from Carling Breweries Limited and Joseph E. Seagram and Sons Limited. Extensive in-plant improvements have and are taking place in the waste-

disposal practices at these two industries. These improvements should reduce operating difficulties at the municipal water pollution control plant.

Within the past few years Carling Breweries Limited has installed a recirculation system for caustic used in bottle washing, and also an automatic neutralizing system to eliminate pH fluctuations. Wastes from the brewery are high in organic content, as determined by BOD and suspended solids analyses, but are comparable to those found at other breweries.

Improvements at Joseph E. Seagram and Sons Limited have greatly reduced the organic loading at the municipal treatment plant, and work is underway to control the pH variations of the wastes. Work done to date appears to have eliminated low pH wastes, and work is continuing to control the wastes with a high pH.

Only two industries, Seagram's and Sunshine Office Equipment Limited, discharge cooling water to storm sewers. These two industries also obtain water from private wells.

The industries listed in Table 6-4 use approximately 1.5 mgd of water, and the remaining industries, those with negligible waste discharges, consume less than 0.1 mgd.

3. Refuse Disposal

A sanitary landfill project serving the city is located on a 40-acre site in the north half of Lot 2, Concession N.E.R. of the Township of Wilmot. Surface-water pollution has not been encountered. The impermeable material that underlies the site should prevent any significant infiltration of contaminating fluids to the ground water.

4. Surface-Water Quality

The results of samples obtained from a storm sewer outlet and from Laurel Creek are shown in tables 6-5 and 6-6. Although a number of storm sewer outlets were located only one contained sufficient flow for sampling purposes. The effluent from the Herbert Street storm sewer exhibited bacteriological characteristics similar to those of domestic sewage. Based on the available analyses, the stream water quality of Laurel Creek downstream from Waterloo is satisfactory.

The effluent from the city's water pollution control plant discharges to the Grand River within the Village of

Bridgeport. A comparison of the water quality of the river in the village immediately upstream from the plant outfall with the quality at the Highway 7 bridge in the Township of Waterloo indicates that the discharge does not result in impairment of the river.

5. Future Requirements

The water pollution control facilities are not providing adequate treatment. At the present average per capita flow of 91 gpd, the plant would have sufficient capacity to accommodate a population of 44,000. But, owing to the fact that the plant is receiving wastes with an organic strength two to three times that normally expected and with varying pH values, improvements are required. The city's consulting engineer is studying the problem and will be presenting a report with recommendations for improvements.

IV CONCLUSIONS

1. Water Supply

The chemical and bacteriological qualities of the present water supply are generally satisfactory. The available quantity from the present and undeveloped well fields will not be adequate to serve the city's requirements beyond about 1969.

Future requirements may be obtainable from adjacent ground-water sources, but it may prove more economical to participate with other municipalities in the area to obtain water from the Great Lakes. The quality of the Grand River water is such that extensive treatment would be required.

2. Pollution Control

The water pollution control on a municipal basis is satisfactory. Treatment is provided for industrial and domestic wastes from virtually the entire developed area of the city.

The water pollution control plant is organically overloaded and the degree of treatment is therefore below that expected. It is anticipated that a consulting engineer's report outlining additional treatment requirements will be presented by mid-1965.

No pollution problems have arisen from the operation of the city's sanitary landfill.

TABLE 6-1

CITY OF WATERLOO - WELL DATA

Well	Date of Construction	Depth (ft)	Diameter (in.)	Aquifer	Screen Length (ft)	Rated Capacity (gpm)	Yield of Well (mgd)	Remarks
1	1943	106	16	Overburden	15	1000	1.44	when Well No.2 not operating
2	1954	108	16	Overburden	15	1000	1.44	when Well No.1 not operating
3	1952	341		Bedrock			0.65	
4	1948	39	16	Overburden	7.5	190	0.29	
5	1955	127	16	Overburden	15	450	1.15	
6	1960	175		Overburden		950	1.00	
							5.97	

TABLE 6-2

CITY OF WATERLOO - CHEMICAL WATER QUALITY

Well	Well** Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
William St. No. 1	W-1	1	514	234	0.56	15	7.2	-
William St. No. 2	W-2	3	502	296	0.15	33	7.4	0.1*
William St. No. 3	W-3	3	1640	183	0.79	4	7.2	1.0*
Dearborn St. No. 4	W-4	2	317	243	0.08	12	7.6	0.1
Shantz No. 5	W-5	4	499	202	1.32	5	7.6	0.3*
Mossburger No. 6	W-6	3	265	241	0.36	5	7.7	0.1

* two samples
** refers to well shown on Figure 3-2

TABLE 6-3

CITY OF WATERLOO - COLONIAL ACRES - CHEMICAL WATER QUALITY

Source	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab
Raw	2	1190	138	2.00	10	7.7
Treated	2	97	165	0.18	8	7.7

TABLE 6-4

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES TO SANITARY SEWER SYSTEM

CITY OF WATERLOO

Industry	Type	Volume (gpd)	Characteristics
Carling Breweries Limited	brewing	600,000	high BOD and suspended solids
General Instruments - F. W. Sickles of Canada Limited	manufacturing	12,000	periodic discharges high in copper and iron
Hager Hinge Canada Limited	manufacturing (plating)	700	plating rinses containing nickel, cadmium, copper and cyanide
Marsland Engineering Limited	manufacturing (plating)	25,000	plating rinses containing cadmium, zinc and cyanide
McEwen - Syer - Moogk Limited	plating	18,000	plating rinses containing copper, nickel, chromium, cadmium, zinc and cyanide
Joseph E. Seagram and Sons Limited	distilling	700,000	periodic discharges high in BOD and suspended solids, and having wide fluctuations in pH
Sunshine Office Equipment Limited	manufacturing (metal finishing)	150,000	approximately one-half the volume is from a private well and is discharged to a storm sewer. Plating wastes contain zinc and cyanide while pickling operations produce batch acidic wastes

TABLE 6-5

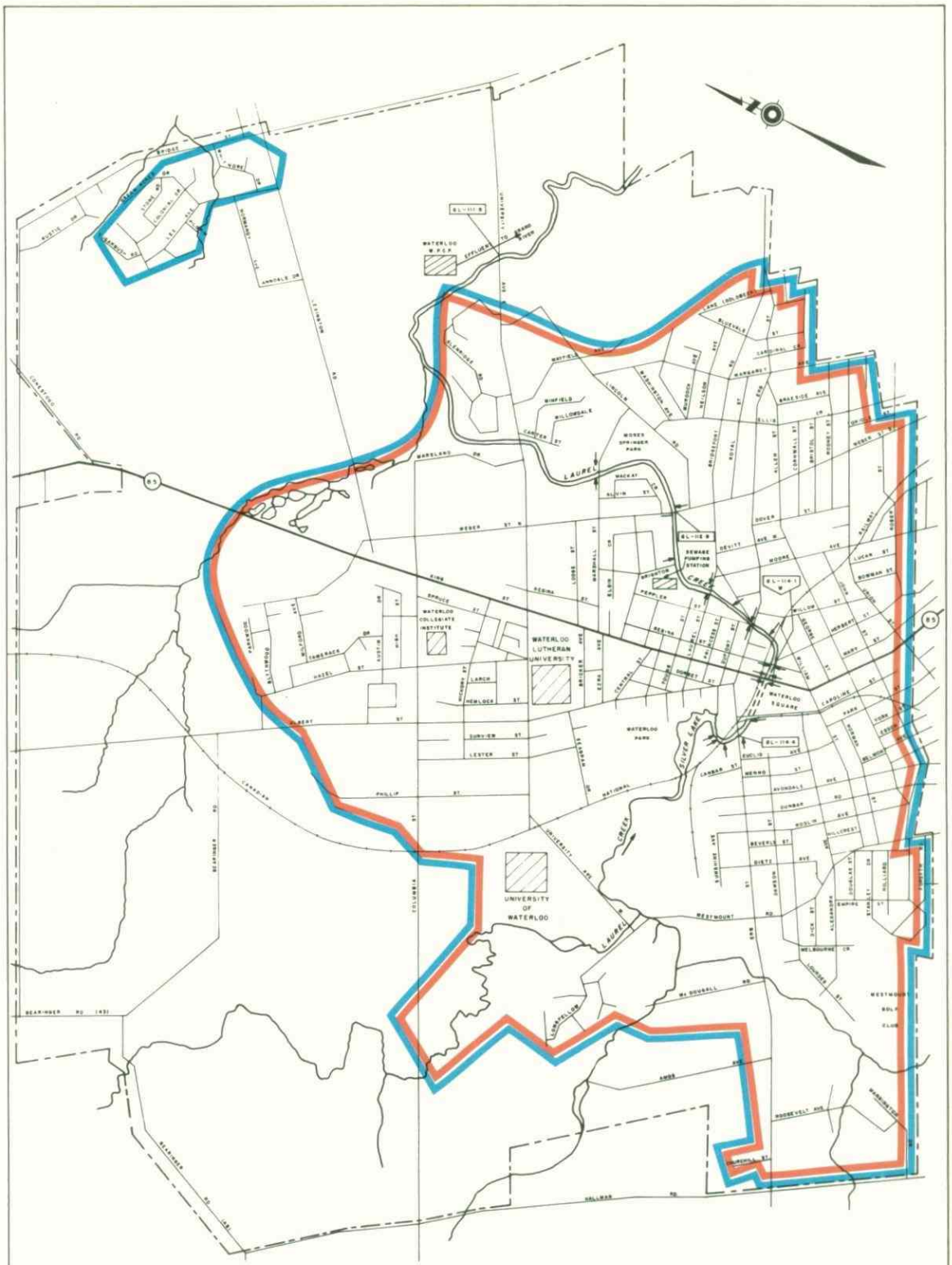
CITY OF WATERLOO - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENT

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
			HERBERT STREET			
GL 114.1W	5.27.65	7.6	300	18		115,000

TABLE 6-6

CITY OF WATERLOO - SAMPLE RESULTS - LAUREL CREEK

			AT UNIVERSITY AVENUE OPPOSITE MUNICIPAL WPCP			
GL 111.5	10.10.63	2.8	478		1.3	
	5.27.65	2.2	400	7		680
			AT ERB STREET			
GL 114.4	5.27.65	3.0	414	73		53,000



LEGEND

- BL-116 1 — SAMPLING POINT SHOWING STREAM AND MILEAGE
- BL-116 1 W — OUTFALL SHOWING STREAM AND MILEAGE — TYPE OF OUTFALL
  - W — STORM SEWER
- BOUNDARY OF WATER AREA
- BOUNDARY OF SEWER AREA
- STORM SEWER OUTFALL (NO FLOW)

ONTARIO WATER RESOURCES COMMISSION

CITY OF WATERLOO

FIGURE 6-1

SCALE : 1000 0 1000 2000 FEET	
DRAWN BY : L.L.B.	DATE : JUNE, 1965
CHECKED BY : A.C.	DRAWING No: 65-77

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CHAPTER 7

TOWN OF ELMIRA

I GENERAL

The Town of Elmira is situated in the northeast portion of the county, at the junction of highways 85 and 86. All drainage in the town is to Canagagigue Creek, a tributary of the Grand River.

Eleven industries, engaged in the production of items including textiles, furniture, farm machinery and chemicals, are located in the town.

The assessed population in 1964 was 3,782.

II WATER SUPPLY

1. Municipal

(a) Source

The Town of Elmira obtains its water supply from three gravel-packed wells which are located in and close to the northwestern section of the town. Well data are listed in Table 7-1. Normally, wells 5 and 6 are used on a regular basis and well 2 is used as an emergency standby because its water is very high in iron.

In August 1960, International Water Supply Limited, carried out a series of pumping tests on the municipal wells and concluded that the aquifer could support a perennial safe yield of about 3 mgd. However, it was pointed out that it was impractical to sustain the present wells at a rate in excess of 2 mgd and because of this it was recommended that an additional well be constructed northwest of well 5.

The wells are equipped with vertical centrifugal pumps, all driven by electric motors. Well 5 is equipped with a gasoline-powered auxiliary motor.

The pumps for wells 5 and 6 are automatically controlled by the level of water in a ground-level reservoir which is located at the well site. The pump at well 2 is manually controlled.

(b) Treatment

No treatment is presently provided the town's water supply. The water enters the ground-level storage reservoir at such a height as to effect a drop to the water surface and a small degree of aeration results. This aeration has the effect of reducing the iron content a limited amount.

(c) Water Pumpage

The average daily water pumpage in 1964 was 1.25 mgd. This represents an overall increase from 1960 of approximately 23 per cent. A summary of water pumpages from 1960 to 1964 is shown below:

	Pumpage				Per Capita	
Year	Total (mg)	Naugatuck Chemicals (mg)	Avg. Day (mg)	Max. Day (mg)	Total (gpd)	Municipal only (gpd)
1960	371.92	295.40	1.02	1.66	317	65
1961	381.06	259.00	1.04	1.68	317	102
1962	387.79	265.50	1.06	1.71	302	95
1963	432.92	293.00	1.19	1.78	328	106
1964	457.30	327.00	1.25	1.80	330	94

As indicated by the foregoing figures, Naugatuck Chemicals uses approximately 70 per cent of the town's average daily pumpage. This has resulted in a very high per capita consumption, much higher than would normally be expected for a town of this size. The overall average daily pumpage has increased approximately 5 per cent per year, due largely to the increasing industrial usage.

(d) Water Quality

The water from the three town wells is hard, and wells 2 and 6 are high in iron. The fluoride content is below that considered effective in the prevention of dental caries. A summary of the analyses of samples submitted to the OWRC Laboratory for chemical-quality determination from 1961 to 1964 is shown in Table 7-2. Average values only are shown as the water has exhibited little variation in quality over the sampling period.

In the past the high iron content has resulted in coloured-water problems throughout the distribution system. Iron bacteria, which are harmless from a health standpoint,

but which often lead to taste and odour problems, have been found at various points in the distribution system. These problems were encountered during the time that well 2 was used as the supplemental source. However, well 6 is now used in conjunction with well 5, well 2 being used only as an emergency standby. It is not known whether the use of well 6 will contribute to the same problems. However, as has been pointed out in the past the installation of iron-removal, and, if necessary, chlorination equipment, could eliminate the problems.

The bacteriological quality of the water has been satisfactory in the past.

(e) Distribution and Storage

The distribution system contains approximately 16.5 miles of mains ranging in size from 2 to 12 inches. There are approximately 1,190 domestic, 270 commercial and 30 industrial services. Five consumers adjacent to the town in the neighbouring Township of Woolwich are served with water from the town. All commercial and industrial services and approximately 75 per cent of the residential services are metered.

Storage is provided by a 0.025-mg elevated tank, located on Dunke Street between Riverside Drive and William Street, and by a 2-compartment, ground-level reservoir, with a total capacity of 0.60 mg, located at the main pumping station at the corner of Victoria and Dunke streets. A 0.33-mg elevated tank is presently under construction and is expected to be in service by mid-1965. It is located in the Gibson Park industrial area.

2. Potential Additional Supplies

(a) Ground Water

A ground-water survey was carried out for Elmira by the Ontario Water Resources Commission in 1960. The subsequent report indicated that there should be additional ground-water supplies available in the area from the overburden and the bedrock.

According to the report, possible overburden sources might be located in a lower aquifer in the bedrock valley to the south and west of Elmira, in an upper aquifer to the northwest, in a lower aquifer to the east and in the kame moraine approximately 3 miles north of the town. A bedrock source might be developed within 3 miles to the northeast of Elmira. A test-drilling program would be needed to establish suitable

locations for the construction of new municipal wells.

(b) Surface Water

In the immediate area of the town no stream is suitable as a source for a municipal water system. The Canagagigue Creek, which flows through the town, has unreliable flow during certain periods of the year and is used at an upstream location for the assimilation of wastes.

3. Future Requirements

The overall average per capita consumption appears to be increasing approximately 2 to 3 per cent per year. If this trend were to continue per capita pumpages of up to 390 gpd could be anticipated in 5 to 10 years. The indicated safe yield of the present wells is approximately 2 mgd. Based on the foregoing per capita pumpages and the indicated safe yield, a population of 5,100 could be adequately served. The projected population figures in Chapter 2 indicate that this figure will not be realized until about 1974.

The relatively large distribution-system storage will enable the town to satisfy maximum demands to be expected in the short-term future.

III WATER POLLUTION

1. Pollution Control Facilities

General

Treatment for domestic and industrial wastes in the town is provided by a 0.68-mgd activated-sludge-type water pollution control plant. The plant was built on a capital- and operating-cost sharing basis by the town and Naugatuck Chemicals and financed by the OWRC.

Because of the variable nature of the strength and the intermittent discharge of the industry's wastes, pre-treatment facilities have been provided ahead of the main plant to equalize in strength and volume the load on the plant. The pre-treatment works consist of a balancing tank, mixing devices and chemical feed equipment for pH control.

The main treatment plant components consist of coarse screens, grit channels, primary settling tanks, aeration tanks, final settling tanks, chlorination facilities and sludge digestion facilities.

Plant Operation

The plant has been in operation since December 1964. To date there has not been sufficient data to assess the operating efficiency. As well as the usual minor problems associated with the start-up of such a plant, the Elmira plant has experienced difficulty with a fibrous industrial waste. Clogging of various portions of the equipment has resulted. Attempts are being made to clear up the problem at the source by fine screens on the waste discharge lines of two industries.

2. Industrial Waste Disposal

Four industries in the town discharge significant amounts of industrial wastes to the system of sanitary sewers. Two other industries discharge their wastes directly to Canagagigue Creek. The industries which discharge to the sanitary sewers are listed in Table 7-3.

Naugatuck Chemicals, a Division of Dominion Rubber Company Limited, has the largest industrial waste discharge. Because of the variable nature of the wastes, with respect to both volume and strength, the wastes undergo pre-treatment before discharge to the municipal water pollution control plant. The pre-treatment facilities consist of a holding tank where blending and pH adjustment are effected. The tank holds approximately 1 day's flow. Due to the operating difficulties experienced at the municipal plant an assessment of the effect of the industrial waste discharge from Naugatuck has not been possible. Naugatuck Chemicals pump some water from Canagagigue Creek, but the remaining water supplies are obtained from the municipal system. Approximately 1 mgd of segregated cooling water is discharged to the creek.

The recent problems with the fibrous wastes received at the plant have been traced to the two textile industries; Borg Fabrics Limited and Robin Textiles Limited. Borg Fabrics Limited is thought to discharge most of the fibres. Both industries, however, have agreed to provide in-plant corrective measures.

Elmira Fertilizers Limited, a plant engaged in the production of fertilizers uses approximately 40,000 gpd of water. Wastes originate in a gas scrubber, and are passed over a bed of limestone before being discharged to Canagagigue Creek. This pre-treatment neutralizes the wastes and causes the fluorides to precipitate.

Elmira Acid and Chemical Limited is engaged in the production of sulphuric acid. Approximately 10,000 gallons of water are used each day. There is normally no effluent from the plant. Most of the water is used for cooling, the remainder being used for replacing evaporation losses from the spray tank or the cooling water recirculation system and for the product.

3. Refuse Disposal

Garbage and refuse in Elmira are disposed of in a landfill project which is located east of Arthur Street and south of the CPR railway line. No pollution problems have been encountered as a result of its operation.

4. Surface-Water Quality

The results of sanitary-chemical and bacteriological examinations of samples of the storm drainage outlets and from Canagagigue Creek are shown in tables 7-4 and 7-5 respectively.

The storm drainage effluent samples exhibited quantities of coliform organisms similar to those found in domestic sewage.

The stream samples were taken prior to the commencement of operation of the Elmira WPCP thereby accounting for the gross contamination shown in the sample analyses downstream of Elmira. Samples taken at the Arthur Street bridge were probably affected by the Gordon Young Limited outfall upstream from the town.

5. Future Requirements

The water pollution control plant was designed to accommodate Naugatuck Chemicals and a town population of 5,000. According to the population projection figures presented in Chapter 2, this population will not be attained until about 1973.

IV CONCLUSIONS

1. Water Supply

The chemical and bacteriological qualities of the present water supply are satisfactory, although some problems could arise due to the high iron content in the well water. The available quantity will only be adequate to serve the town's

short-term future needs. Additional ground-water supplies should be available within 3 miles of the town. There is no reliable surface-water source in the area.

2. Water Pollution

Water pollution control on a municipal basis is generally satisfactory although two storm sewers continue to receive some domestic waste discharges.

The water pollution control on a municipal basis is satisfactory. Treatment is provided for industrial and domestic wastes from virtually all the developed areas of the town.

Industrial waste discharges from two firms have resulted in upsetting the municipal treatment plant process but it is expected that the problem will be overcome at the industries.

No pollution problems have resulted from the operation of the town's sanitary landfill.

TABLE 7-1

TOWN OF ELMIRA - WELL DATA

Well	Date of Construction	Depth (ft)	Diameter (in.)	Aquifer	Screen Length (ft)	Rated Capacity (gpm)	Yield of Well (mgd)	Remarks
2	1944	132	20	Overburden	10	400	.58	Used only for standby purposes
5	1947	113	20	Overburden	20	800	1.15	
6	1956	86	18	Overburden	20	1000	1.44	
							3.17	Recommended pumping rate is 2.0 mgd

TABLE 7-2

TOWN OF ELMIRA - CHEMICAL WATER QUALITY

Well	Well**** Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
2	E-2	5	534	249	1.70	20	7.5	0.4**
5	E-5	5	527	232	0.28	9	7.6	0.4***
6	E-6	3	529	221	0.64	6	7.3	0.3*

* one sample
** two samples
*** four samples
**** refers to well shown on Figure 3-2

TABLE 7-3

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES TO SANITARY SEWER SYSTEM

TOWN OF ELIMIRA

Industry	Type	Volume (gpd)	Characteristics
Borg Fabrics Limited	textile	17,000	some BOD but main problem is suspended solids (fibre)
Naugatuck Chemicals	chemical	200,000	high COD and phenols
Robin Textiles Limited	textile	12,000	some BOD but main problem is suspended solids (fibre)
Silverwood Dairies Limited	dairy	20,000	high BOD

TABLE 7-4

SAMPLE RESULTS - MUNICIPAL AND INDUSTRIAL WASTE EFFLUENTS

TOWN OF ELMIRA

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	pH at Lab	Fluoride as F (ppm)	MF Coliform Count/100 ml
GCG 126.7I	Elmira Fertilizer Plant	5.12.65	1.6	2710	64	3.3	40.5	0
GCG 127.0D1	Ditch at Union St.	5.12.65	0.9	538	2			900
GCG 127.0D2	Ditch at Church St. and Hwy. 86	5.12.65	1.4	604	10			37,000
GCG 127.4W1	SE Side Arthur St. Bridge	5.12.65	4.2	660	5			15,400,000
GCG 127.4W2	SW Side Arthur St. Bridge	5.12.65	1.8	582	8			300,000

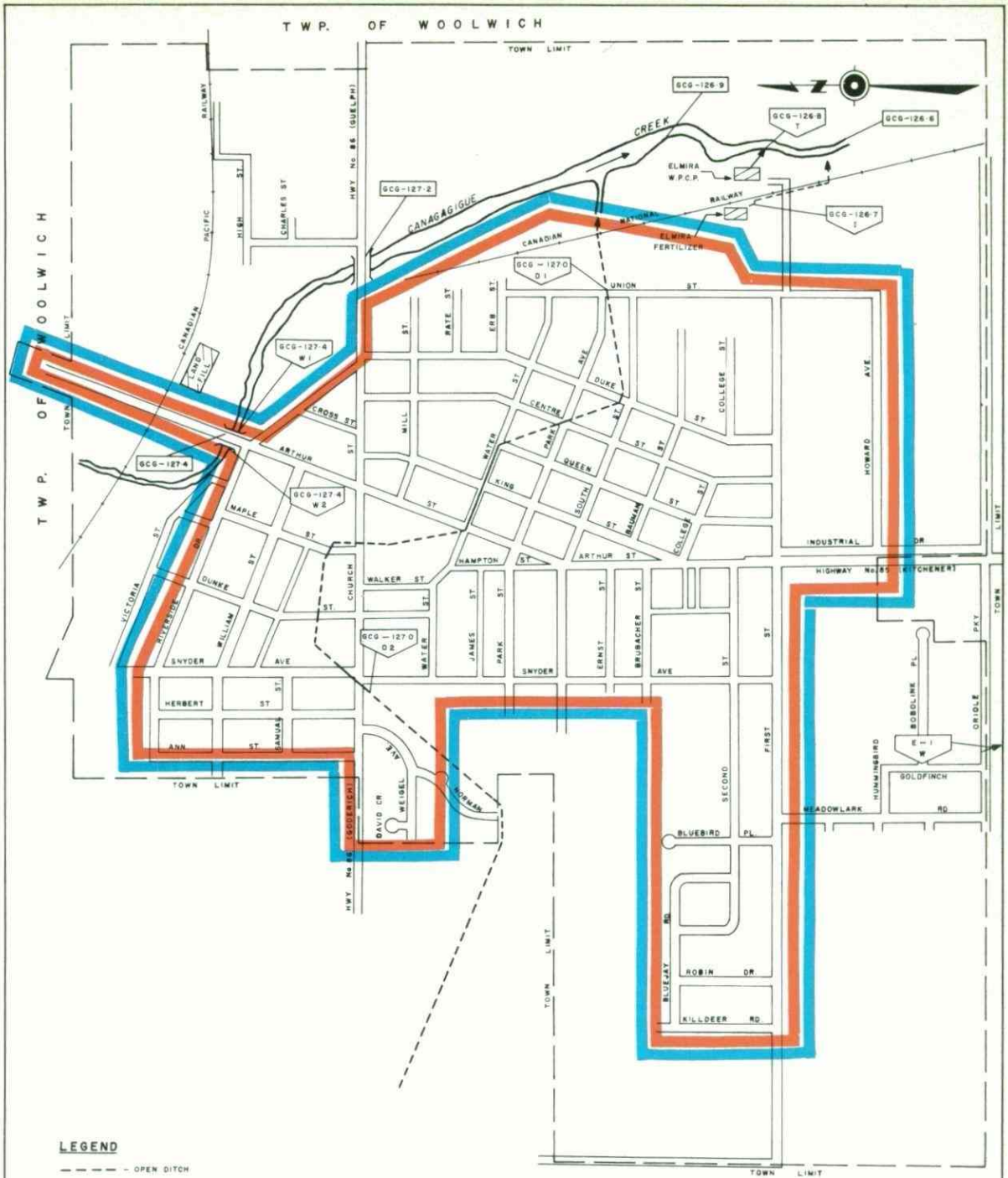
TABLE 7-5

TOWN OF ELMIRA - SAMPLE RESULTS - CANAGAGIGUE CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	COD (ppm)	pH at Lab	Phenols (ppb)	Ether Solubles (ppm)	Iron as Fe (ppm)	Temp. (°C)	DO (ppm)
DOWNSTREAM FROM WPCP OUTFALL											
GCG 126.6	2.12.64	37	1094	19	92	7.2	600	7	1.25	5.8	7.9
	3.19.64	7.6	528	9	40	7.3	40	0	0.51	2.2	10.4
	4.15.64	7.6	494	29	56	8.1	50	2.4	0.58	8.0	9.8
	5.12.64	20	866	25	72	7.9	300	0	0.72	16.8	3.3
	7.15.64	17	510	18	90	8.0	50	6	1.08		
Average		18.0	698	20	70	7.7	210		0.82		
DOWNSTREAM FROM NAUGATUCK OUTFALL, UPSTREAM FROM FORMER WPCP OUTFALL											
GCG 126.9	2.12.64	80	1210	53	172	7.0	2,000	8	3.75	5.5	8.8
	3.19.64	20	604	6	60	7.5	70	0	0.41	0.2	10.6
	4.15.64	6.4	464	20	40	8.2	60	Trace	0.50	7.8	10.2
	5.12.64	24	822	35	68	7.5	700	0	0.86	17.0	5.2
	7.15.64	20	482	14	56	8.4	160	4	1.16		
Average		30.0	716	25	80	7.7	600		1.33		

TABLE 7-5 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	COD (ppm)	pH at Lab	Phenols (ppb)	Ether Solubles (ppm)	Iron as Fe (ppm)	MF Coliform Count/100 ml	Temp. (oC)	DO (ppm)
					BRIDGE AT HIGHWAY 86							
GCG 127.2	8.28.63	8.8	500	7						0		
	6.23.63	9.2	382	5				0		150,000		
	2.12.64	67	1208	19	56	7.8	7		0.44			
	3.19.64	1.2	362	8	12	8.0	20	0	0.3		0	12.3
	4.15.64	1.6	458	62	24	8.2	8	2	0.6		8.0	11.2
	5.12.64	3.6	348	4	20	8.2	25	0	0.24		12.2	8.8
	7.15.64	4.2	350	10	26	8.4	12	2	1.08			
Average		13.6	472	16	27	8.1	14		0.53			
					BRIDGE AT ARTHUR STREET							
GCG 127.4	10. 8.62	4.2	310							6,600		
	6. 9.64	2.7	380	6						1,150		
	6.23.64	20.0	418	1				4		590,000		
	8.14.64	13	482	13			4			90,000		
Average		9.9	397	7								



LEGEND

- ——— – OPEN DITCH
- GCG-127-2 – SAMPLING POINT SHOWING STREAM AND MILEAGE
- GCG-127-4 W1 – OUTFALL SHOWING STREAM AND MILEAGE
  - TYPE OF OUTFALL
  - W – STORM SEWER
  - I – INDUSTRIAL WASTE
  - D – DITCH
  - T – TREATMENT PLANT
- – BOUNDARY OF WATER AREA
- – BOUNDARY OF SEWER AREA

ONTARIO WATER RESOURCES COMMISSION	
TOWN OF ELMIRA FIGURE 7-1	
SCALE: 600 0 600 FEET	
DRAWN BY: L.L.B	DATE: MAY, 1965
CHECKED BY: A.C.	DRAWING No: 65-69

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CHAPTER 8

TOWN OF HESPELER

I GENERAL

The Town of Hespeler is situated near the east boundary of the county just north of Highway 401 on the banks of the Speed River, a tributary of the Grand River. The entire town drains to the Speed River.

The major industries in the town are engaged in the production of textiles, while other industries are engaged in the production of metal wares, furniture and washing machines.

The assessed population in 1964 was 4,950.

II WATER SUPPLY

1. Municipal

(a) Sources

The water supply for the Town of Hespeler is obtained from six rock wells, five of which are located within the town. Well data are listed in Table 8-1.

Wells 3, 4 and 5 are the principal sources of water supply. Normally, two of these three wells are operated at the same time. Wells 1 and 2 are used as standby sources. Well 6 is used mainly as a standby for fire fighting.

All the wells are equipped with electrically driven, vertical centrifugal pumps which are controlled by pressure and are adjusted to operate when the pressure falls below 60 psi.

The present capacity of the six wells is 2.1 mgd; however, the yield of good-quality water is only 0.88 mgd.

A seventh well located on Hespeler Road near Galt was under construction in the early part of 1965.

(b) Treatment

The only treatment provided on a municipal basis is the chlorination and aeration of wells 1 and 2 for the removal of hydrogen sulphide. Many of the consumers have individual

water-softening units.

(c) Water Pumpage

A summary of water pumpages from 1960 to 1964 is shown below:

Year	Pumpage Total (mg)	Pumpage Avg. Day (mg)	Pumpage Max. Day (mg)	Per Capita (gpd)
1960	127.54	0.348	0.888	78
1961	127.24	0.349	0.525	77
1962	141.32	0.388	0.577	76
1963	146.23	0.401	0.732	83
1964	130.60	0.357	0.436	72

It is noted from the foregoing figures that the average daily pumpage is well below the estimated available supply of good-quality water, but that the maximum daily demand has equalled that available. The construction of a new well which was proposed for early 1965 should provide sufficient additional water to meet at least the short-term future demands.

(d) Water Quality

A summary of the analyses of samples submitted for chemical-quality determination from 1960 to 1964 is shown in Table 8-2. The quality of water in each of the wells has shown little variation in quality over the sampling period. For this reason the summary contains only average values. The samples received for analyses from wells 1 and 2 are based on combined samples taken from the plant reservoir.

The water from all the wells is very hard and the water from wells 1, 2 and 6 is high in iron.

The water from well 3 was chlorinated prior to distribution during 1960 and 1961 to combat taste and odour problems which resulted from the presence of iron bacteria. However, chlorination has not been practised for the past 3 years and the problem has not recurred.

(e) Distribution and Storage

Wells 1 and 2 deliver water to a ground-level reservoir at the main pumping station from which it is pumped to the

distribution system. The remaining four wells pump directly to the distribution system.

The distribution system consists of approximately 14 miles of mains ranging in size from 4 to 10 inches. There are approximately 1,210 domestic, 65 commercial and 19 industrial services. The system is almost totally metered.

Storage is provided by a 0.23-mg, ground-level reservoir at the main pumping station, and a 0.10-mg elevated tank on the distribution system.

2. Potential Additional Supplies

(a) Ground Water

Like most municipalities in the county, the Town of Hespeler is favourably located with respect to the availability of ground-water supplies. The bedrock in the vicinity of the town consists of the Guelph-Lockport formation. The formation is composed largely of dolomite and normally has good water-yielding characteristics. On the other hand, the base of the Salina formation is located approximately 2 miles to the west and at least one rock well which yields mineral water has been reported just beyond the western boundary of the town. Such conditions and the presence of Galt and Preston close to the south, will impose some limits on the development of additional water supplies from the bedrock in those directions.

Records show that very few wells obtain water from the overburden in the Hespeler area. The bedrock is the most favourable potential source for additional supplies in the area to the north of the town.

It would be necessary to carry out a program of test drilling to determine the quantity and quality of additional ground-water supplies and the most favourable locations for future wells.

(b) Surface Water

The Speed River could be used for additional water supply; however, its waters would require extensive treatment to make it suitable for municipal use.

3. Future Requirements

Average per capita pumpages in the past have been as high

as 83 gpd, while maximum per capita pumpages have been as high as 152 gpd. The total yield of the present good-quality water is approximately 0.88 mgd. These figures suggest that during maximum-demand periods a population of 5,800 could be adequately served. The projected population figures in Chapter 2 indicate that this figure will be realized about 1970.

III WATER POLLUTION

1. Pollution Control Facilities

General

Essentially all the developed portion of the town is served by sanitary sewers, which receive domestic wastes from all residents and industries. These wastes are provided only primary sedimentation followed by seasonal sand filtration. Four of the larger industries in the town discharge untreated industrial wastes directly to the Speed River.

The sedimentation tank capacity is 0.067 mg. It provides an approximate retention of 4 hours, based on the estimated average daily flow of 0.40 mg. Six intermittent sand filters, located on the south bank of the Speed River, comprise a total area of 1.4 acres and provide additional treatment during the summer months.

Treatment Efficiency

A summary of the analyses of samples of the raw sewage and final plant effluent from 1961 to 1964 is shown below:

		5-Day BOD				Suspended Solids			
Year	No. of Samples	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1961	12								
Raw Sewage		146	250	100		152	290	106	
Primary Effluent		105	155	70	28	96	134	72	37
Sand Filter Effluent[1]		30	80	9	79	29	60	12	81
1962	11								
Raw Sewage		159	275	66		168	382	98	
Primary Effluent		132	245	65	17	113	137	58	33
Sand Filter Effluent[2]		34	80	7	79	47	84	15	72
1963	13								
Raw Sewage		151	340	80		215	519	136	
Primary Effluent		104	170	62	31	92	176	56	57
Sand Filter Effluent[3]		36	88	10	76	33	84	23	85

Year	No. of Samples	5-Day BOD Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Suspended Solids Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1964	6								
Raw Sewage		121	235	50		171	228	88	
Primary Effluent		89	155	70	26	78	117	54	54
Sand Filter Effluent[4]		7	12	4	94	17	24	11	90

1-8 samples
2-9 samples
3-11 samples
4-5 samples

The foregoing results indicate that inadequate treatment is being provided by the municipal water pollution control plant. The OWRC objectives with respect to both BOD and suspended solids concentrations in discharges to natural watercourses are 15 ppm. The sand filter effluent samples in 1964 showed BOD and suspended solids values within the objectives; however, these are not representative of year-round discharges, as sand filtration is only practised during the summer months.

Sewage Flows

There is no provision for the measurement of sewage flows at the town's water pollution control plant. However, it is generally recognized that the average municipal water pumpage relates closely to the waste flow. It may be expected, therefore, that average flows up to 0.4 mgd will reach the plant.

2. Industrial Wastes

Four industries in the town have what are considered to be significant industrial waste discharges. Two are textile mills and two are manufacturing plants. A brief summary of these industries is provided in Table 8-3.

Wastes from all these industries are discharged to the Speed River. Artex Woollens Limited and Simplicity Products, both located on the north side of the river, discharge wastes through municipal sewers to the river. Dominion Woollens and Stamped and Enamelled Ware, on the south bank, discharge wastes directly to the Speed River.

The textile wastes contain relatively high concentrations of BOD and suspended solids. When municipal water pollution control facilities become available the textile wastes will require a very large portion of the treatment capacity. In

the design of a municipal plant these textile wastes will be the most important consideration.

Wastes from the two manufacturing plants originate mainly in processes used to prepare metal surfaces for painting or enamelling. The wastes contain alkaline cleaners, phosphates and neutralizing rinses. Due to the nature of these wastes they may not be acceptable at a municipal biological water pollution control plant without some form of pre-treatment.

3. Refuse Disposal

Garbage and refuse are disposed of at a landfill operation located north of Beaverdale Road, adjacent to the Speed River. There have been no pollution problems associated with this operation.

4. Surface-Water Quality

The results of samples taken from municipal and industrial waste outlets and from the Speed River are shown in tables 8-4 and 8-5 respectively. Gross pollution is exhibited in the effluent samples. These discharges as well as discharges of inadequately treated wastes from the municipal pollution control plant have resulted in the deterioration in stream quality, as shown in the samples taken downstream from Hespeler.

The locations of the municipal and industrial waste outlets and stream sampling points are shown on Figure 8-1.

5. Future Requirements

The water pollution control facilities are inadequate, and as a result, contaminated wastewater is discharged to the Speed River. The four main industries in the town discharge untreated wastewater directly to the river.

A consulting engineer has been retained by the town to prepare plans and specifications for a complete secondary treatment water pollution control plant.

IV CONCLUSIONS

1. Water Supply

The chemical quality of the water supply is generally satisfactory. Samples taken for bacteriological examination indicate a safe supply.

The present available quantity is adequate to serve the

town's needs until approximately 1970. With the anticipated completion of the seventh well, under construction in the early part of 1965, the town will be in a favourable position with respect to water supply.

2. Pollution Control

The town has a commitment to meet in the provision of water pollution control facilities. Pollution of the Speed River occurs as a result of the inadequate treatment provided by the present facilities as well as the discharge of untreated wastes from some of the industries.

There have been no problems arising from the operation of the town's landfill.

TABLE 8-1

TOWN OF HESPELER - WELL DATA

Well	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Rated Capacity (gpm)	Yield of Well (mgd)
1	1934			Bedrock	250*	
2	1934			Bedrock	250*	
3	1948	208	10	Bedrock	200	0.28
4	1950	168	12	Bedrock	170	0.24
5	1954	193	-	Bedrock	250	0.36
6	1954	226	-	Bedrock	350	0.50

* the pumps have been equipped to pump at this rate, but the yield has not been determined

TABLE 8-2

TOWN OF HESPELER - CHEMICAL WATER QUALITY

Well	Well* Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab
1 and 2	H-1,2	18	448	338	1.88	48	7.3
3	H-3	20	286	233	0.07	9	7.6
4	H-4	20	304	254	0.05	13	7.5
5	H-5	20	315	239	0.17	19	7.5
6	H-6	13	377	306	1.03	43	7.3

* designation refers to well shown on Figure 3-2

TABLE 8-3

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES

TOWN OF HESPELER

Industry	Type	Volume (gpd)	Characteristics
Artex Woollens Limited	textile	400,000	high BOD and suspended solids
Dominion Woollens and Worsteds (1959) Limited	textile	800,000	high BOD and suspended solids
Simplicity Products	manufacturing	30,000	wastes from metal cleaning and painting operations
Stamped and Enamelled Ware	manufacturing	1,250,000	periodic discharges containing suspended solids, cleaning and enamelling compounds

TABLE 8-4

SAMPLE RESULTS - MUNICIPAL AND INDUSTRIAL WASTE EFFLUENTS

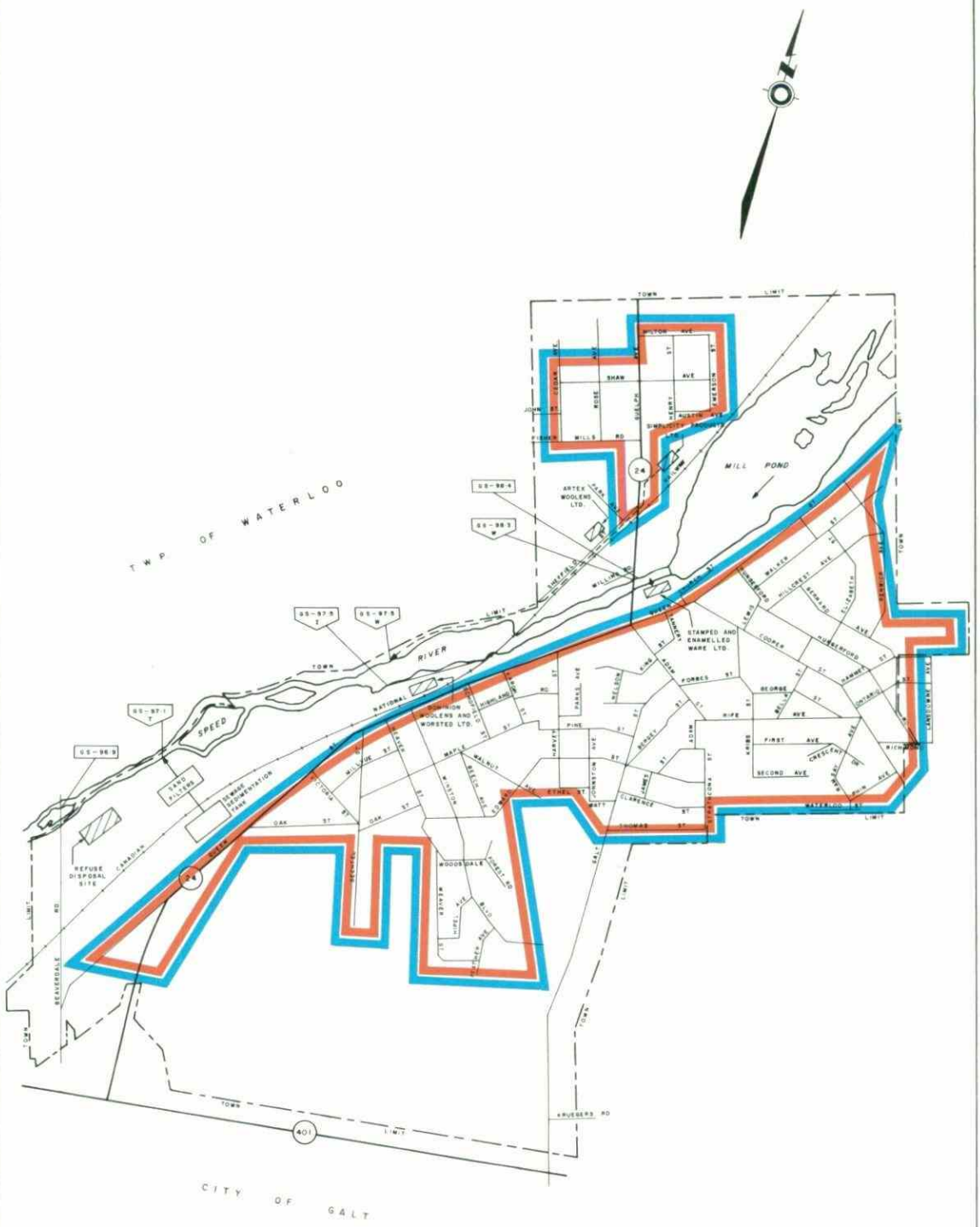
TOWN OF HESPELER

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GS 97.5I	5.25.65	Mill Race Downstream from Dominion Woollens' Outfall	7.2	754	24	97,000
GS 98.3W	5.25.65	Storm Sewer Effluent, N. Side Guelph Ave. Bridge	5.0	474	11	6,700
GS 97.5W	5.25.65	Sheffield St.	37.0	1584	64	2,900

TABLE 8-5

TOWN OF HESPELER - SAMPLE RESULTS - SPEED RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Temp. (oC)	DO (ppm)
			AT BEAVERDALE BRIDGE					
GS 96.9	7.18.60	10	396		6	171,000		
	8.23.61	4.2	596		3	19,000		
	10.10.62	6.4	442		70	68,000		
	2.14.63	9.2	502		7.5	172,000		
	10. 9.63	10	582		8.0	137,000		
	7.20.64	3.3	700	18	16	137,000	28.5	7.2
	8.31.64	7.2	512	20		604,000	22.5	8.4
	10. 5.64	1.2	578	7	8.0	48,000		
	12.15.64	6.7	392	8	16	89,000	1.0	12.2
	1.26.65	15.0	612	23	4.0	12,000,000	1.5	12.6
	2.22.65	29.0	426	14	10.0	610,000	0.2	12.8
Average		9.3	521	15	15			
			AT DAM ABOVE STAMPED AND ENAMELLED WARE					
GS 98.4	7.18.60	4.0	382		6	130		
	8.23.61	2.4	450		2	16		
	7.30.63	4.4	486	67	30	1,700		
	10. 9.63	3.7	500		10.5	330		
Average		3.6	454		12			



LEGEND

GS-98.9 – SAMPLING POINT SHOWING STREAM AND MILEAGE

GS-97.5 I – OUTFALL SHOWING STREAM AND MILEAGE
– TYPE OF OUTFALL

I – INDUSTRIAL WASTE

T – TREATMENT PLANT

W – STORM SEWER

– BOUNDARY OF WATER AREA

– BOUNDARY OF SEWER AREA

ONTARIO WATER RESOURCES COMMISSION

TOWN OF HESPELER

FIGURE 8-1

SCALE 600 0 600 FEET	
DRAWN BY L.L.B.	DATE JULY, 1965
CHECKED BY A.C.	DRAWING No. 65-86

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CHAPTER 9

TOWN OF PRESTON

I GENERAL

The Town of Preston is situated in the southeastern portion of the county at the confluence of the Speed and Grand rivers. Drainage from the town is to these two rivers.

Fifteen manufacturing industries are located within the town. Products include plastics, machinery, castings, footwear, food-stuffs and automobile accessories.

The 1964 assessed population was 12,365.

II WATER SUPPLY

1. Municipal

(a) Source

The Town of Preston presently obtains its water supply from six wells and a spring. An additional well, well 5, is maintained only for standby purposes because of the poor chemical quality of the water. Another well, the Witmer Well, will be placed in service in 1965. The town owns two additional wells but they are not yet equipped for service. Well data are listed in Table 9-1.

The spring supply, which was developed in the early part of the century, is located in the northern section of the town at the base of the northern bank of the Speed River valley. A maximum yield of 150 gpm from this source was recorded but since 1958 it has varied from 35 to 100 gpm.

The present source of water supply should be capable of yielding water at an average rate of 2.74 mgd, which includes the flow from the springs. However, these sources are only capable of supplying 1.8 mgd of good-quality water. The connection of the Witmer Well to the system will increase the rate of yield by 0.72 mgd. In 1964 a 1.5-mg reservoir was placed in service in order to have enough water reserve in case of emergency.

(b) Treatment

Water from the spring supplies and wells 2 and 5 are pumped to a ground-level reservoir at the main pumping

station. The water is then chlorinated prior to distribution. No other treatment is provided. Many of the consumers provide water softening on an individual basis.

(c) Water Pumpage

A summary of water pumpages from 1960 to 1964 inclusive is shown below:

Year	Pumpage Total (mg)	Pumpage Avg. Day (mg)	Pumpage Max. Day (mg)	Per Capita (gpd)
1960	376.77	1.030	1.763	91
1961	388.67	1.070	1.466	93
1962	420.00	1.150	1.753	99
1963	434.46	1.190	1.767	99
1964*	509.14	1.390	1.837	112

* not considered accurate due to reasons indicated below

Up to 1963 the average daily water pumpage has shown a gradual increase each year, but during 1964 there was a marked increase. This has been attributed to major leaks in the distribution system and a faulty meter on one of the wells. These problems have since been overcome.

(d) Water Quality

The water from all the wells is very hard. The Goetz Well is the only one to exhibit an iron content in excess of the 0.3-ppm objective for potable water supplies. Apart from the hardness and the high iron content in the one well, the water is generally satisfactory from a chemical-quality standpoint. The fluoride content in all wells is below the 1.0-ppm level considered beneficial in the prevention of dental caries.

A summary of the results of chemical analyses of samples submitted to the OWRC Laboratory from 1961 to 1964 is shown in Table 9-2. Only average values are presented as the water has not shown significant variations in quality over the sampling period.

The water from the two spring supplies and wells 2 and 5 has consistently been shown to contain coliform organisms. For this reason all water from these sources is chlorinated prior to distribution. The bacteriological quality of the

water from the distribution system has been satisfactory.

(e) Distribution and Storage

The water from the spring supplies and wells 2 and 5 is pumped to a ground-level reservoir at the main pumping station. From there it is pumped to the distribution system.

The distribution system consists of approximately 48.6 miles of mains ranging in size from 4 to 16 inches. There are approximately 3,010 domestic, 205 commercial and 50 industrial services. The town serves seven consumers on Pinebush Road in the City of Galt and seven consumers in the Township of Waterloo.

Storage is provided by two ground-level reservoirs at the main pumping station, with capacities of 0.10 and 0.20 mg. Two high-elevation tanks, one a standpipe, the other a ground-level reservoir, are also provided. The standpipe has a capacity of 0.127 mg, the ground-level reservoir 1.5 mg.

2. Potential Additional Supplies

(a) Ground Water

The western section of the town is underlain by the Salina formation which normally yields water with an unsatisfactory chemical quality. This means that additional, good-quality water supplies from aquifers in the bedrock are likely to be limited to the area east and north of the town.

There is a possibility that additional water supplies may be obtained from the overburden in the vicinity of Blair and Doon and in certain areas north of Highway 401. Domestic wells in these areas indicate extensive, although somewhat irregular, deposits of sand and gravel.

Ground-water conditions in the area within, and to the north of, Preston were reviewed in detail in a ground-water survey report prepared by the OWRC in 1963 at the request of the Preston Public Utility Commission.

The development of ground water in a limited area in the City of Galt east of the town is covered by an agreement involving the municipalities of Preston and Galt and the Ontario Water Resources Commission.

(b) Surface Water

The Grand and Speed rivers could be used as additional sources for municipal water supply; however, their waters would require extensive treatment.

Although the short-term water-supply requirements can be met from the present supply, the town should co-operate with other municipalities to consider a pipeline system from one of the Great Lakes as the long-term solution to the water-supply problem.

3. Future Requirements

Average per capita water pumpages in the past have been as high as approximately 100 gpd, while maximum per capita pumpages have been as high as 155 gpd. The total yield of the present good-quality water is approximately 2.5 mgd. These figures suggest that a population of 16,100 can be adequately supplied during maximum-demand periods. According to the projected population figures presented in Chapter 2 this population will not be realized until about 1973.

III WATER POLLUTION

1. Pollution Control Facilities

General

Domestic and most industrial wastes from the Town of Preston are treated in a 1.8-mgd activated-sludge-type water pollution control plant. The plant was designed to serve a population of 15,000 at a per capita flow of 120 gpd. It was placed in service in February 1963 and was constructed under joint agreement between the town and the OWRC.

The treatment process consists of grit removal, coarse screening and shredding, primary settling, aeration, final settling, chlorination of the effluent, sludge storage and raw-sludge vacuum filtration. The effluent is discharged to the Grand River.

The entire developed portion of the town is served by sanitary sewers. Many of the sewers are very old and ground-water infiltration results in excessive wet-weather flows. Also, roof drains and catch basins are connected to the sanitary sewers and add further to storm-water flows.

Treatment Efficiency

The efficiency of the treatment plant is indicated by

the following summary of the results of samples submitted to the OWRC Laboratory during 1963 and 1964.

Year	No. of Samples	5-Day BOD Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Suspended Solids Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1963	21								
Raw Sewage		480	700	240		551	900	274	
Final Effluent		31	215	6	94	27	116	3	95
1964	14								
Raw Sewage		428	550	245		549	948	232	
Final Effluent		17	47	4	96	13	47	2	98

The foregoing figures suggest that satisfactory treatment was being achieved during 1963 and 1964. The per cent reductions were within the range expected from this type of plant.

Sewage Flows

A summary of sewage flows received at the plant for the period from February 1963 to December 1964 is presented below:

	1963*	1964
Total Flow (mg)	284.18	284.32
Average Flow (mgd)	0.84	0.78
Maximum Flow (mgd)	1.40	1.30
Per Capita Flow (gpd)	70	63
Sewage Flow to Water Consumption Ratio	0.71	0.56**

* flow records from January 28
** water consumption figures not considered accurate

The average flow received at the plant has been well below the 1.8-mgd design flow. Also, the per capita flows have been well below the design per capita flow of 120 gpd.

2. Industrial Wastes

Hostess Food Products Limited is the only large source of BOD and suspended solids discharging to the municipal water pollution control plant. Five other industries discharge metal-finishing wastes. Three of these have only periodic discharges from metal pickling and bonderizing

processes and two have discharges from plating operations. The industries with significant waste discharges are summarized in Table 9-3.

Kayson Plastics and Chemicals Company Limited use approximately 0.30 mg of water daily. This is used almost exclusively for cooling reactors in which styrene is polymerized in extruders for forming polyethylene. The wastes are discharged to a small retention pond from which they flow to a creek that becomes a municipal storm drain and eventually reaches the Grand River.

In the polymerization process liquid styrene leaks from the reactors to the plant sewers, and the large flow of cooling water washes the styrene through the retention pond before separation of the styrene and the liquid can be effected. The styrene polymerizes in the receiving ditch and storm sewer resulting in sewer maintenance problems. Recent process changes have eliminated some of the styrene and a proposed cooling water recirculation system should solve this problem. The recirculation system should reduce the waste flow to 0.05 mgd and should result in improved separation of the styrene and liquid. The effect of the reduced waste flow should, however, be assessed to determine if increased retention-pond capacity is required.

3. Refuse Disposal

Refuse in Preston is disposed of at a partial landfill project at the north end of Russ Street. Clean fill is used to cover the top, but there is an open face. Although the project is adjacent to the Speed River, surface-water pollution has not been encountered.

4. Surface-Water Quality

The results of samples obtained from wastewater outlets and from the Speed River within the municipality are shown in tables 9-4 and 9-5 respectively. Although a number of outfalls were located only two contained flow. The effluent from both showed slight contamination.

Results of samples obtained from the Speed River exhibit the effects of upstream waste discharges. There is no significant deterioration in quality as it passes through the town. Reference should be made to the sections dealing with the Township of Waterloo or the City of Galt for upstream and downstream analyses of samples obtained from the Grand River. The locations of the municipal waste outlets and

stream sampling points are shown on Figure 9-1.

5. Future Requirements

Based on the present average per capita flows, the water pollution control facilities appear to have adequate capacity. If the access of ground water and rain water were to be eliminated from the sanitary sewers the life expectancy of the plant would be further increased.

IV CONCLUSIONS

1. Water Supply

The present available supply should be adequate to serve the town's present and future needs until approximately 1973. The long-term solution to the water-supply problem should be based on a pipeline system from one of the Great Lakes in co-operation with other municipalities in the county.

The chemical and bacteriological qualities of the present water supply is generally satisfactory.

2. Pollution Control

The sewage collection system serves the entire developed portion of the town and satisfactory treatment is being provided.

An assessment of the effect of the reduced waste flow should be made at Kayson Plastics and Chemicals Company to ascertain if increased retention-pond capacity is required.

There is no problem arising from the operation of the town's refuse disposal area.

TABLE 9-1

TOWN OF PRESTON - WELL DATA

Well	Name	Year of Construction	Depth (ft)	Diameter (in.)	Aquifer	Rated Capacity (gpm)	Yield of Well or Field (mgd)	Remarks
2		1939	170	8	Bedrock	75	0.11	
4		1943	205	10	Bedrock	50	.07	
5		1950	165	10	Bedrock	650	.93	used only for standby purposes because of the water quality
6		1951	290	8	Bedrock	330	0.36	wells 6 and 7 act in sympathy
7		1951	380	10	Bedrock	100		
9		1959	263	10	Bedrock	400	0.58	
10	Goetz (T.H.2-59)	1959	211	8	Bedrock	400	0.58	
	Witmer (T.H.2-58)	1958	275	10	Bedrock	500		will add 0.72 gpd to system when well connected
							2.63	

TABLE 9-2

TOWN OF PRESTON - CHEMICAL WATER QUALITY

Well	Well* Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
2	P-2	5	394	256	0.05	47	7.4	0.1
Upper Spring		3	303	253	0.08	26	7.6	0.2
Lower Spring		2	282	230	0.08	26	7.5	0.3
4	P-4	4	378	280	0.07	51	7.4	0.4
5	P-5	1	822	206	0.12	33	7.3	
6	P-6	5	298	190	0.15	12	7.6	0.5
7	P-7	3	301	249	0.17	15	7.5	0.4
9	P-9	5	266	239	0.10	11	7.6	0.2
10 (Goetz)	P-10	2	263	270	0.75	8	7.8	0.1

* designation refers to well shown on Figure 3-2

TABLE 9-3

INDUSTRIES DISCHARGING SIGNIFICANT INDUSTRIAL WASTES TO SANITARY SEWER SYSTEM

TOWN OF PRESTON

Industry	Type	Volume (gpd)	Characteristics
Canadian Office and School Furniture Limited	manufacturing	16,000	periodic discharges from a bonderizing process
Clare Brothers Limited	manufacturing	27,000	periodic discharges from pickling and phosphating processes
Daisy Manufacturing Company Limited	manufacturing	200,000	plating rinses containing copper, nickel, cyanide
Hostess Food Products Limited	potato chips	100,000 to 200,000	high BOD and solids
Konder Manufacturing Company Limited	manufacturing	9,000	plating rinses containing zinc and cyanide
Kralinator Filters Limited	manufacturing	20,000	periodic discharges from a steel pickling process

TABLE 9-4

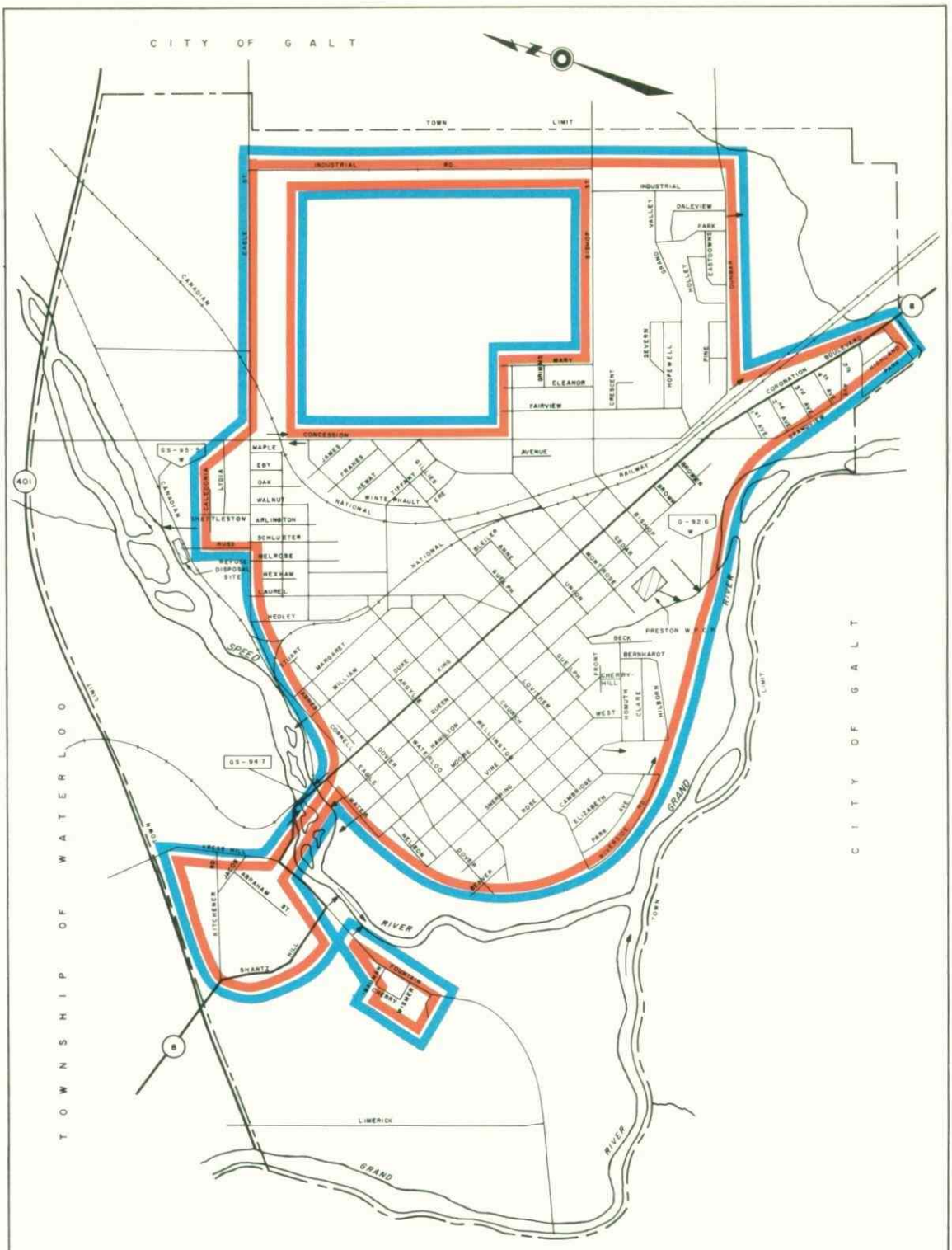
TOWN OF PRESTON - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENTS

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	MF Coliform Count/100 ml
		AT END OF RUSS STREET			
GS 95.5W	5.27.65	1.2	402	4	9,600
		AT END OF BISHOP ST.			
G 92.6W	3.24.64	1.8	470	5	13,400
	5.20.64	0.6	508	2	9,900
	5.27.65	19	542	25	10
Average		6.9	506	11	

TABLE 9-5

TOWN OF PRESTON - SAMPLE RESULTS - SPEED RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Turbidity Units	MF Coliform Count/100 ml
			AT HIGHWAY 8			
GS 94.7	7.18.60	4.2	366		11	129,000
	8.23.61	2.6	484		3	170
	7.30.63	6.2	388	28		
	10. 9.63	3.1	554		4.0	2,800
Average		4.0	663		5.9	



LEGEND

GS-94.7 – SAMPLING POINT SHOWING STREAM AND MILEAGE

GS-95.5 W – OUTFALL SHOWING STREAM AND MILEAGE – TYPE OF OUTFALL

W – STORM SEWER

– BOUNDARY OF WATER AREA

– BOUNDARY OF SEWER AREA

– STORM SEWER OUTFALL (NO FLOW)

ONTARIO WATER RESOURCES COMMISSION	
TOWN OF PRESTON	
FIGURE 9-1	
SCALE: 1000 0 1000 FEET	
DRAWN BY: L.L.B.	DATE: JUNE, 1965
CHECKED BY: A.C.	DRAWING No: 65-72

CHAPTER 10

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CHAPTER 10

VILLAGE OF AYR

I GENERAL

The Village of Ayr is situated near the southern boundary of the county, approximately 2 miles south of Highway 401. The Nith River, a tributary of the Grand River, flows through the village. All lands in the village drain to the Nith River.

Ayr supports four industries which are engaged in the production of feed and metal products. The village is the centre of a progressive agricultural area.

The 1964 assessed population was 1,078.

II WATER SUPPLY

1. General

Water is presently obtained from individual wells. Most of the wells are dug, but there are a moderate number of drilled wells. Two springs also supply water in the village.

There is a very good flowing well in the village but at present the water is conducted to a pond in the middle of the village. Recently a well with a capacity of approximately 30,000 gpd was constructed to supply a new subdivision consisting of 65 homes.

2. Potential Additional Supplies

(a) Ground Water

The report on the ground-water survey made by this Commission in 1959 indicated that the village was favourably located in an area where ground water should be readily available from the overburden. The bedrock is composed of the Salina formation which normally yields a very hard water with other undesirable chemical qualities.

Favourable potential sources of an adequate ground-water supply for the municipality are the present flowing well or wells in the areas described in the ground-water survey report. The area near the eastern boundary of the village appears to be particularly favourable.

(b) Surface Water

The Nith River could be used for additional water supply; however, its waters would require extensive treatment for municipal use. No streamflow records are available for Cedar Creek and therefore its potential could not be assessed.

3. Future Requirements

It is indicated that there are favourable potential sources of an adequate ground-water supply for the municipality within the village.

Future growth of the Village of Ayr may necessitate the provision of a municipal supply.

III WATER POLLUTION

1. Pollution Control Facilities

General

The Village of Ayr has no communal waste treatment facilities. Treatment is provided by individual septic tank systems, many of which do not function satisfactorily. Several have outlets which discharge directly to local watercourses, particularly in the business area around the mill pond and Cedar Creek. Most of the lots in the business area are not sufficiently sized to accommodate field tile disposal beds.

2. Future Requirements

Corrective action will be required in order to eliminate problems associated with the operation of individual septic tank systems. The problem could best be resolved by the provision of a municipal sewage works.

3. Refuse Disposal

The municipality disposes of refuse at an open-face dump on a hillside at the south end of the village. There are no pollution problems as a result of its operation.

4. Surface-Water Quality

The results of surface-water samples taken from the Nith River and Cedar Creek are shown in tables 10-1 and 10-2. The sample analyses show the effects of the waste

discharges which result from the faulty septic tank systems in the village.

The locations of the stream sampling points are shown on Figure 10-1.

IV CONCLUSIONS

1. Water Supply

The individual wells which serve the residents and business establishments in the village appear to be satisfactory from a quality and quantity standpoint. As the village grows, however, the provision of a municipal water-supply system should be considered.

2. Pollution Control

Owing to the fact that many of the property owners are experiencing sewage-disposal problems consideration should be given to the construction of a municipal sewage works.

There are no pollution problems arising from the operation of the refuse disposal area.

TABLE 10-1

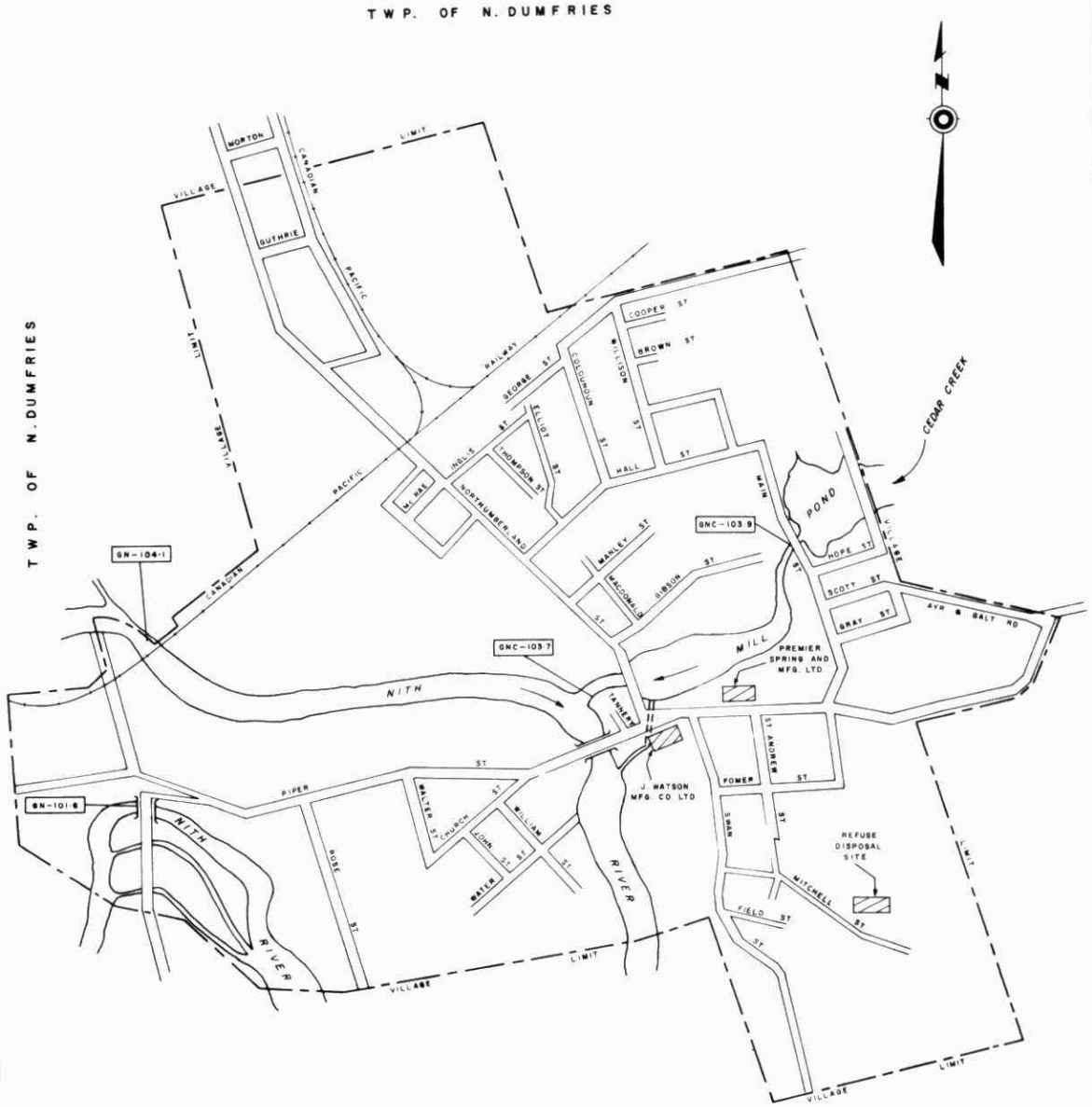
VILLAGE OF AYR - SAMPLE RESULTS - NITH RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Total Solids (ppm)	Turbidity Units	MF Coliform Count/100 ml
		DOWNSTREAM FROM AYR			
GN 101.6	10.10.62	3.0	434	2.9	1,400
	5.21.63	3.1	352	11.5	1,090
	10. 8.63	1.9	420	2.6	21,000
	12. 2.64	3.0	436	3.8	72
Average		2.7	410	5.2	
		UPSTREAM FROM AYR			
GN 104.1	8.30.61	3.0	442	5	56
	12. 2.64	3.0	436	3.8	72

TABLE 10-2

VILLAGE OF AYR - SAMPLE RESULTS - CEDAR CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Total Solids (ppm)	Turbidity Units	MF Coliform Count/100 ml
			AT MOUTH		
GNC 103.7	7.21.60	2.3	282	3	800
	8. 4.60	2.9		11	2,000
	8.30.61	3.5	400	1	4,700
	10. 9.62	2.4	350	2.9	3,900
	12. 2.64	2.8	396	1.0	420
Average		2.8	357	4.0	
			AT BRIDGE AT NE END OF VILLAGE		
GNC 103.9	7.21.60	2.4	322	5	40
	8.30.61	2.7	434	1	82
	10. 9.62	1.7	368	2.6	30
	10. 8.63	1.2	398	1.1	154
	12. 2.64	2.0	402	1.5	630
Average		2.0	385	2.2	



LEGEND

GN-101 6 – SAMPLING POINT SHOWING STREAM AND MILEAGE

ONTARIO WATER RESOURCES COMMISSION	
VILLAGE OF AYR FIGURE 10-1	
SCALE 500 250 0 500 FEET	
DRAWN BY L.L.B	DATE JUNE, 1965
CHECKED BY A.C	DRAWING No 65-75

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CHAPTER 11

VILLAGE OF BRIDGEPORT

I GENERAL

The Village of Bridgeport is situated on the Grand River adjacent to the city limits of Kitchener and Waterloo. All drainage of the village is to the Grand River, either directly or via its tributary, Laurel Creek.

The village supports six light industries employing approximately 30 workers. The majority of the village's work force commute daily to the nearby industrial centres of Kitchener and Waterloo.

The assessed population in 1964 was 1,821.

II WATER SUPPLY

1. Municipal

The Village of Bridgeport is supplied by water from the City of Kitchener. Under an agreement, the village pays for all capital costs while the city maintains the system.

2. Potential Additional Supplies

Since the village is serviced by an extension of the Kitchener water distribution system it is not likely that it would contemplate developing a separate water supply.

3. Future Requirements

The City of Kitchener will be able to supply the future water needs of the village.

III WATER POLLUTION

1. General

One portion of the village, estimated to constitute less than one-quarter of the total population, is served by sanitary sewers which discharge to the City of Kitchener system. The sewage enters the city system at the Oxford Street pumping station. The remainder of the village is served by individual septic tank systems, many of which do not function

satisfactorily. This is due in part to inadequate field tile systems, brought about by the small-sized lots and adverse soil conditions.

2. Refuse Disposal

Refuse collected in the village is disposed of at the City of Kitchener sanitary landfill project.

3. Surface-Water Quality

Analyses of surface water and municipal waste effluent samples are shown in tables 11-1, 11-2 and 11-3.

The effluent sample analyses indicate the presence of domestic sewage. The results of samples from the Grand River at Bridgeport exhibit intermittent contamination, and a small degree of pollution is also noted in Laurel Creek at the sampling point downstream from the village.

The locations of the stream sampling points and municipal waste effluents are shown on Figure 11-1.

4. Future Requirements

Individual sewage disposal systems are not satisfactory in many cases in the Village of Bridgeport. As a result, active consideration should be given to extending the sanitary sewers throughout the village.

IV CONCLUSIONS

1. Water Supply

The water supply, which is obtained from the City of Kitchener, is adequate and satisfactory.

2. Pollution Control

Pollution problems exist in the Village of Bridgeport. The small-sized lots and adverse soil conditions make the use of individual disposal systems difficult. Consideration should be given to the extension of the sanitary sewer system.

TABLE 11-1

VILLAGE OF BRIDGEPORT - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENTS

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GL 110.35W1	4. 5.61	Northeast Corner of	6.8	798	24	247,000
	5.14.65	Bridge at Bridge St.	3.6	1,036	9	1,070,000
GL 110.35W2	4. 5.61	Southwest Corner of	18	1,146	108	6,900
	5.14.65	Bridge at Bridge St.	58	1,560	51	5,300,000

TABLE 11-2

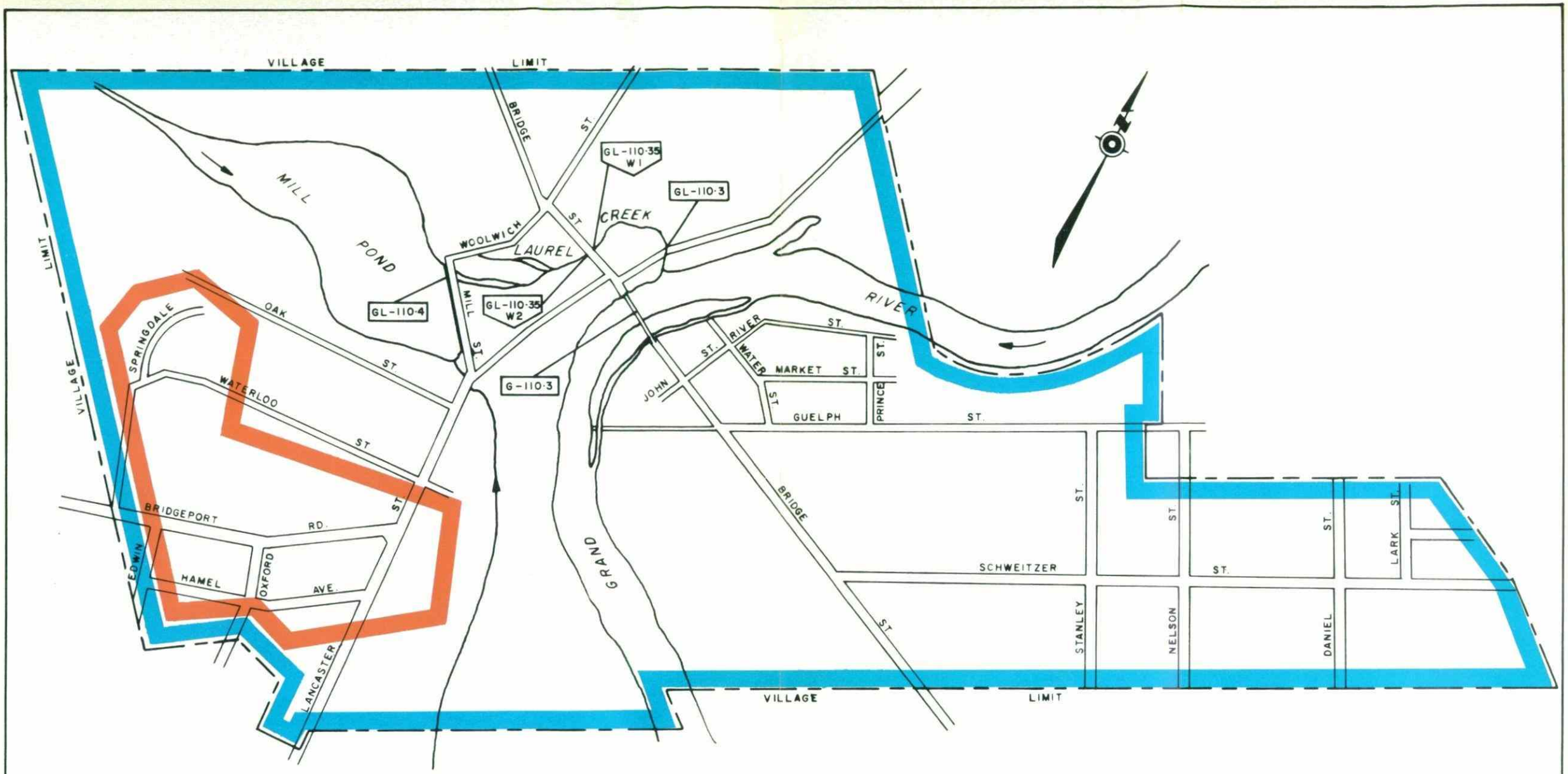
VILLAGE OF BRIDGEPORT - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Phenols (ppb)	Anionic Detergents as ABS (ppm)	Phosphate as PO_4 (ppm)	MF Coliform Count/100 ml	Temp. (°C)	DO (ppm)
					AT BRIDGEPORT BRIDGE						
G 110.3	7.19.60	4.0	228	24					4,000		
	4.19.61	3.2	280		5	10			17		
	8.22.61	1.6	324		4				210		
	10. 9.62	1.5	302		2.6				660		
	2.14.63	3.7	406		3.8				580		
	10. 9.63	1.3	258		4.0				600		
	12.16.63	3.6	374	6			0.2	.15	7,900		
	12.17.63	3.8	360	4			0.1	.12	4,900		
	12.18.63	3.4	326	4			Trace	.15	51,000		
	1.13.64								2,400		
	1.20.64	2.7	436	2		18	0.1	0.22	2,800		
	1.22.64	3.3	430	6			0.1	0.3	500		
	2.10.64	1.9	398		1.4		Trace	0.15	106		
	2.12.64	2.1	430		1.7	17	Trace	.16	900	28	6.7
	7.20.64	1.1	306	23	12				20		
	8.31.64	1.3	336	24					240	21.5	9.2
	10. 5.64	1.5	262	3	5.0				240	10	
	12.15.64	3.0	346	9	9.0				1,560	0.25	12.8
	1.26.65	2.4	448	11	4.5				11,000	.25	13.2
	2. 2.65	1.7	304	6					100	.2	13.0
Average		2.5	345	10	4.8						

TABLE 11-3

VILLAGE OF BRIDGEPORT - SAMPLE RESULTS - LAUREL CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			AT BRIDGE AT MOUTH				
GL 110.3	7.19.60	3.5	204		10	91,000	
	4. 5.61	2.6	300		9	630	
	4.19.61	2.8	340		10	420	
	8.22.61	2.7	354		3	40,000	
	10. 9.62	6.6	368		8	21,000	
	2.14.63	40	1026		11	6,300	1,500
	10. 9.63	5.3	432		6.5	23,000	
Average		9.1	433		8		
			AT DAM				
GL 110.4	6. 8.59	5.0	730	40		75,000	
	7. 9.59	7.8	396		6		
	9.17.59	1.6	438	8			
	4. 5.61	2.1	358		8	60	
	10.10.63	4.7	458		4	130	
Average		4.2	476		6		



LEGEND

G-110·3 – SAMPLING POINT SHOWING STREAM AND MILEAGE

GL-110·35 W1 – OUTFALL SHOWING STREAM AND MILEAGE
– TYPE OF OUTFALL

W – STORM SEWER

– BOUNDARY OF WATER AREA

– BOUNDARY OF SEWER AREA

ONTARIO WATER RESOURCES COMMISSION

VILLAGE OF BRIDGEPORT

FIGURE II-1

SCALE: 200 0 200 600 1000 FEET

DRAWN BY: L.L.B. | DATE: JUNE, 1965

CHECKED BY: A.C. | DRAWING No: 65-74

CHAPTER 12

VILLAGE OF NEW HAMBURG

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CHAPTER 12

VILLAGE OF NEW HAMBURG

I GENERAL

The Village of New Hamburg is situated in the extreme western area of the county just north of Highway 7 and 8. The town is drained to the Nith River, a tributary of the Grand River.

The village supports only one major manufacturing industry, which is engaged in the production of brass wares. Other industries are engaged in metal finishing and in the production of footwear, dairy products and wood crafts.

The 1964 assessed population was 2,215.

II WATER SUPPLY

1. Municipal

(a) Source

The present water supply for the village is obtained from a well, Park Station No.2, located in the southeast part of the village adjacent to the Nith River, and from a spring collection system located approximately 1.5 miles north of the well. About one-half of the municipal water supply is obtained from each source.

The municipal well was constructed in 1963. The depth of the well is 29 feet and its protective casing has a diameter of 38 inches. The well penetrates coarse sand and gravel beds. The rated capacity of the well is 300 gpm.

The springs originate near the base of a moraine in the eastern section of a 70-acre area owned by the village. The spring water, together with the surface runoff, drains into two collection ponds. The ponds have a total volume of approximately 600,000 gallons. Approximately 50 acres of the 70 acres owned by the village is covered by bush while the remaining 20 acres has been reforested.

(b) Treatment

Water for the spring supply is chlorinated prior to distribution. No other treatment is provided the water from either of the sources.

(c) Water Pumpage

The average daily water pumpage has shown an overall increase of 15.8 per cent from 1960 to 1964. The maximum year occurred in 1963 when a total of 71.69 mg was pumped. A summary of water pumpage figures from 1960 to 1964 is shown below:

Year	Pumpage			
	Total (mg)	Avg. Day (mg)	Max. Day (mg)	Per Capita (gpd)
1960	57.780	0.158	0.271	75
1961	60.324	0.165	-	78
1962	59.130	0.162	-	76
1963	71.690	0.196	-	91
1964	67.080	0.183	0.481	83

(d) Water Quality

The water from both sources is hard, the well water being somewhat harder than the spring supply. The average iron content in the well water exceeds the OWRC objective of 0.3 ppm, and the fluoride content in both supplies is well below the level considered beneficial in the control of dental caries.

A summary of the results of the analyses of samples submitted to the OWRC Laboratory for chemical-quality determination from 1960 to 1964 is shown in Table 12-1. Since the quality of the well water has not varied appreciably over the sampling period only average values are presented.

(e) Distribution and Storage

It is estimated that approximately 98 per cent of the village's population is supplied by the municipal water works system. Approximately eight residences on Perth Street north of the CNR tracks are not provided with municipal water. These rely on private wells.

The distribution system consists of approximately 8.2 miles of mains, ranging in size from 4 to 10 inches. There are approximately 490 domestic, 56 commercial and 17 industrial services.

Storage is provided by two, open, raw-water reservoirs, with capacities of 0.20 and 0.40 mg, at the spring-supply pumphouse, and by an elevated tank, with a capacity of 0.12 mg,

on the system in the north end of the village.

2. Potential Additional Supplies

(a) Ground Water

At the end of 1962 eight test holes were drilled in the eastern section of the village. As a result of the program, the present municipal well was constructed in 1963. If the present supply becomes inadequate, it is planned to construct another well in the northern part of the village near the Nith River.

The test holes revealed that the hydrogeologic conditions are such that wells along the river obtain water from the river by infiltration through the underlying sand and gravel layers.

According to the Commission's ground-water survey in the area another good source of ground water could possibly be developed west and southwest of the village.

(b) Surface Water

The Nith River could be used for additional water supply, but the river has periods when flows are extremely low making it an unreliable source.

3. Future Requirements

Allowing for an available supply of 225,000 gpd from the springs the total yield of the present water supply is approximately 657,000 gpd. This amount indicates that a population of approximately 7,300 can be adequately supplied during average-demand periods based on a per capita consumption of 91 gpd. Allowing for a maximum demand of twice average, a population of 3,650 could be adequately supplied during maximum-demand periods. The population projection figures presented in Chapter 2 suggest that this population will not be attained until about 1979.

III WATER POLLUTION

1. Pollution Control Facilities

General

Domestic and most industrial wastes in the village are treated in a 14-acre waste stabilization pond. The pond was designed to receive the wastes from an equivalent contributory

population of 1,400 at 100 persons per acre. The pond was constructed under joint agreement between the village and the OWRC and has been in operation since August 1962. The lagoon effluent discharges to the Nith River.

Approximately 75 per cent of the village is presently served by sanitary sewers. The portion of the town north of the CNR tracks, which is the area not served by sewers, is served by individual septic tank systems. Most of the systems reportedly function well but as the land is flat and poorly drained some problems do exist.

Treatment Efficiency

A summary of the analyses of the samples of the raw sewage and final effluent submitted to the OWRC Laboratory for analyses from January 1963 to December 1964 is shown below:

		5-Day BOD				Suspended Solids			
Year	No. of Samples	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)	Avg. (ppm)	Max. (ppm)	Min. (ppm)	Red. (%)
1963	11								
Raw Sewage		470	860	170		361	764	176	
Final Effluent		167	640	40	64	100	190	38	72
1964	9								
Raw Sewage		405	800	160		413	868	213	
Final Effluent		63	165	25	84	69	110	50	83

The average BOD and suspended solids concentrations in the raw sewage are much higher than those of normal domestic sewage. The concentrations in the final effluent are correspondingly high. The high strength of the raw sewage has been attributed to the discharge of dairy wastes to the sanitary sewers. Arrangements have been made with the industries concerned to reduce these discharges, and improved effluent quality should result.

Sewage Flows

A summary of the waste flows received at the waste stabilization pond during 1964 is shown below:

Total Flow (mg)	-	34.179
Average Flow (mgd)	-	0.093
Maximum Flow (mgd)	-	-
Average Per Capita (gpd)	-	56*
Sewage Flow to Water Consumption Ratio	-	0.68**

* based on 75 per cent of population
** based on per capita figures

The average daily flow and the average raw-sewage BOD indicate that the pond is receiving an organic load of approximately 27 pounds per acre per day, some 35 per cent in excess of the normal design loading of 20 pounds per acre per day. However, as pointed out previously, measures have been taken to reduce the load through the control of dairy waste discharges.

2. Industrial Waste Disposal

The industrial wastes from the Hamburg Felt Boot Company Limited and Hahn Brass Limited were investigated as part of the survey.

The Hamburg Felt Boot Company Limited produces felt, and the wastes, although small in volume, contain a significant amount of sulphuric acid. A batch neutralization tank was built to pre-treat the wastes before discharge to the municipal sanitary sewers.

Hahn Brass Limited discharges approximately 0.05 mg of wastes per day to the Nith River. Most of the waste is from electro-plating processes, and contains zinc, copper, nickel, chromium and cyanide. The in-plant waste streams have been segregated and pre-treatment facilities for the destruction of cyanide and the reduction of hexavalent chromium have been installed. The final stage of the plant's treatment will provide settling facilities to remove suspended solids.

3. Refuse Disposal

Refuse collected in the village is disposed of at a landfill project. The site is located south of the municipality in part of an ox-bow of the Nith River adjacent to the New Hamburg waste stabilization pond. The ox-bow was formed when the route of the river was changed to accommodate construction of the pond. Stagnant water lies in the former river bed beyond the disposal area, but there is no discharge and no

pollution problems have resulted.

4. Surface-Water Quality

The results of the analyses of surface-water samples obtained within the municipality are shown in tables 12-2 and 12-3.

Although a number of storm sewer outlets were located only one contained sufficient flow for sampling. The discharge from the sewer indicates the presence of domestic sewage. The stream sample analyses show the river to be of generally satisfactory quality.

The locations of the stream sampling points and storm sewer outlets are shown on Figure 12-1.

5. Future Requirements

The water pollution control facility has been receiving highly concentrated wastes as a result of dairy waste discharges. If these discharges are reduced by eliminating the more concentrated components of the wastes, the life expectancy of the facility will be increased. If the strong discharges continue, additional treatment capacity will be required in the near future.

Sanitary sewers will be required in the unsewered areas of the village where drainage problems exist.

IV CONCLUSIONS

1. Water Supply

The chemical and bacteriological qualities of the present water supply are satisfactory.

The present available supply should be adequate to serve the town's needs until about 1979.

2. Pollution Control

The sewage collection system serves approximately 75 per cent of the population; the program of extending the sanitary sewers should be continued.

Hahn Brass Limited will require settling facilities to remove suspended solids from the plant's industrial waste discharge.

There are no problems of pollution arising from the operation of the town's refuse disposal area.

TABLE 12-1

VILLAGE OF NEW HAMBURG - CHEMICAL WATER QUALITY

Source	Well ** Designation	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Spring Supply								
Avg.		7	237	224	0.16	6	7.8	0.1*
Max.			266	264	0.36	9	8.1	0.2
Min.			206	192	0.00	4	7.5	0.1
Well Supply	NH-1	3	439	290	0.36	37	7.5	0.2

* three samples only
** designation refers to well shown on Figure 3-2

TABLE 12-2

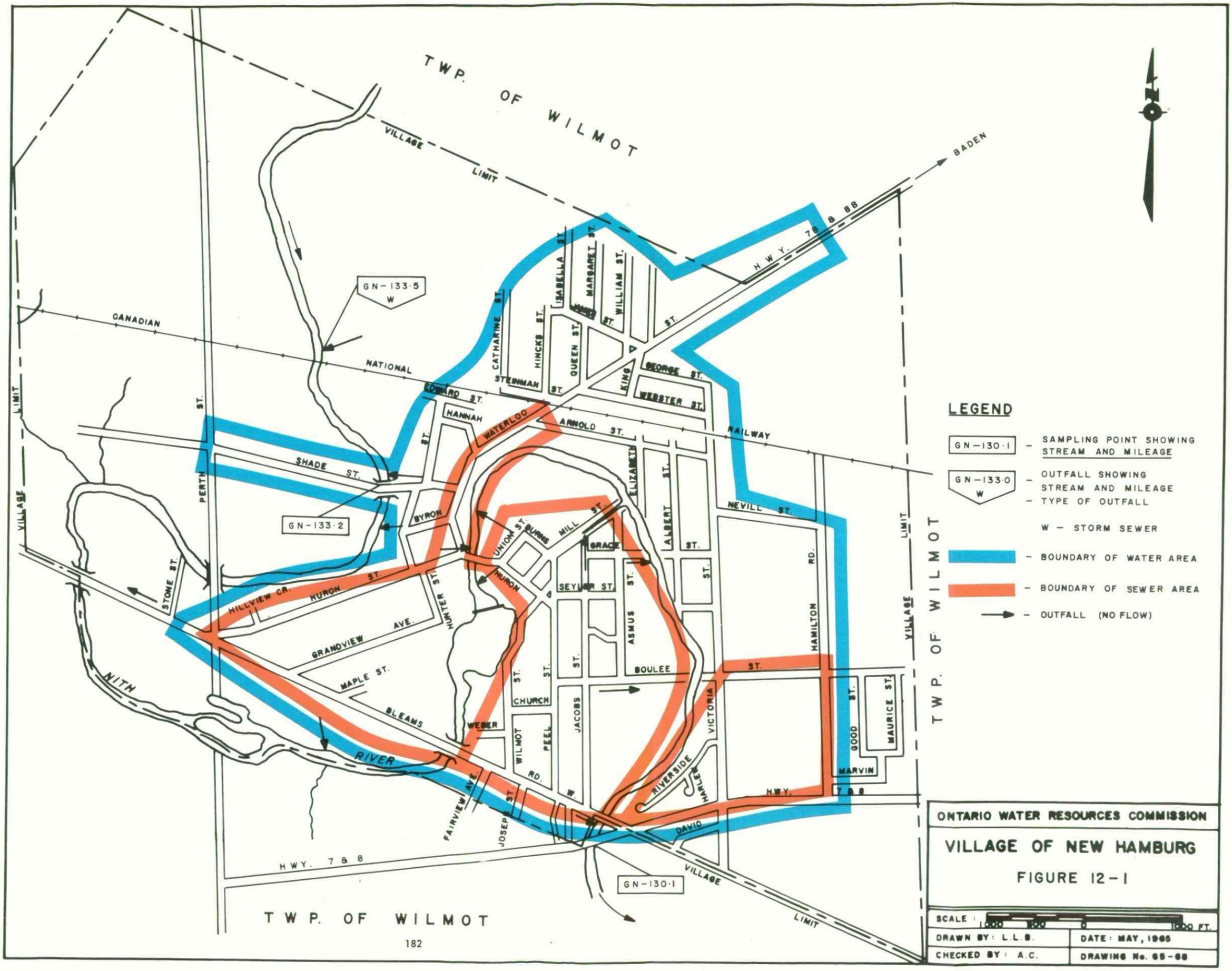
VILLAGE OF NEW HAMBURG - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENTS

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
GN 133.5W	Storm Sewer from William St. at the Nith River	5.13.65	5.4	374	7		1,970,000

TABLE 12-3

VILLAGE OF NEW HAMBURG - SAMPLE RESULTS - NITH RIVER

GN 130.1	At Highway 7 and 8 By-pass	7.21.60	2.6	322	36		840
		8.30.61	2.6	302		8	428
		10. 9.62	3.2	334		8.5	1,200
		10. 8.63	2.5	304	20		460
Average			2.7	316	28	8.2	
GN 133.2	At Shade St. Bridge	7.21.60	1.7	256	22		420
		8.30.61	2.2	298		11	210
		10. 9.62	2.6	314		12	14,000
Average			2.2	289		12	


TWP. OF WILMOT
VILLAGE LIMIT
BADEN
HWY. 7 & 8
GN-133-5 W
CANADIAN NATIONAL RAILWAY
CATHARINE ST.
ISABELLA ST.
MARGARET ST.
WILLIAM ST.
HINCKS ST.
QUEEN ST.
KING
GEORGE ST.
WEBSTER ST.
STERNMAN
EDWARD ST.
HANNAH
WATERLOO
ARNOLD ST.
SHADE ST.
PERTH
GN-133-2
BYRON
UNION ST.
BURNS
MILL ST.
GRACE
ELIZABETH ST.
ALBERT ST.
NEVILL ST.
LIMIT
VILLAGE
STONE ST.
HILLVIEW CR.
HURON ST.
HUNTER ST.
GRANDVIEW AVE.
MAPLE ST.
NITH
BLEAMS
WEBER
CHURCH
SEYLER ST.
ASMUS ST.
BOULEE
HAMILTON RD.
WILMOT
PEEL
JACOBS
VICTORIA
GOOD
MAURICE ST.
MARVIN
RIVERSIDE
HARLEY
RIVER
FAIRVIEW AVE.
JOSEPH ST.
DAVID
GN-130-1
TWP. OF WILMOT
LEGEND
GN-130-1 – SAMPLING POINT SHOWING STREAM AND MILEAGE
GN-133-0 W – OUTFALL SHOWING STREAM AND MILEAGE – TYPE OF OUTFALL
W – STORM SEWER
– BOUNDARY OF WATER AREA
– BOUNDARY OF SEWER AREA
– OUTFALL (NO FLOW)
ONTARIO WATER RESOURCES COMMISSION
VILLAGE OF NEW HAMBURG
FIGURE 12-1
SCALE : 1000 500 0 1000 FT.
DRAWN BY: L.L.B.
DATE: MAY, 1965
CHECKED BY: A.C.
DRAWING No. 65-68

CHAPTER 13

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CHAPTER 13

VILLAGE OF WELLESLEY

I GENERAL

The Village of Wellesley is situated in the northwest portion of the county on a small tributary of the Nith River. All drainage in the village is to this watercourse.

The village is a commercial centre for the surrounding agricultural area. Light industry in the village is engaged in the production of farm feeds and apple butter and cider.

The assessed population in 1964 was 675.

II WATER SUPPLY

1. General

There is no municipal water works system in the village. The majority of the homes are supplied from three private water works while the rest of the homes have individual wells. The residents consider that present water supplies from the communal systems are quite satisfactory. The quality of the water from these systems is generally satisfactory although the iron content is higher than the recommended limit.

The bacterial quality of the water from the communal systems is monitored by the Waterloo County Health Unit through a program of the collection of monthly samples.

2. Private

(a) Lichti Water Works

This water works system serves approximately 10 homes in the west part of the village and is owned by Mrs. L. Lichti. The water is supplied by a bedrock well drilled in 1955. The well is 228 feet deep, has a 5-inch casing, and is reported to be capable of yielding 200 gpm. The water is pumped directly to the consumers without treatment.

The chemical quality of the water is given in Table 13-1. The water is hard and has an iron content that exceeds the recommended upper limit of 0.3 ppm. The fluoride content is within the range deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(b) Wagner Water Works

The Wagner water works system is the largest and oldest of the three systems, and supplies water for approximately 115 homes. The water comes from an overburden well, drilled to a depth of 165 feet. The well has a 6-inch-diameter casing and there are three pumps on the system each capable of delivering 1,000 gph. A 10,000-gallon reservoir has recently been constructed to provide storage and assist in iron removal.

The chemical quality of the water is given in Table 13-1. The water is hard and the iron content exceeds the recommended upper limit of 0.3 ppm. The average fluoride content is at the optimum level of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(c) Erb Water Works

The Erb water works system is located immediately beyond the western boundary of the village, but some of the homes supplied are within the village. Reference should be made to Chapter 16 for details of the system.

3. Potential Additional Supplies

(a) Ground Water

From the available well records it appears that there are good aquifers in both the overburden and the bedrock. The aquifer in the overburden is confined to a sand and gravel layer which is overlain by varying thicknesses of clay and till. In most places the water is under artesian pressure in this aquifer.

The bedrock underlying the Village of Wellesley belongs to the Bass Island formation and it also yields substantial amounts of ground water.

A ground-water survey followed by a test-drilling program would be required to locate the more favourable sites for municipal wells.

(b) Surface Water

There are no surface waters in the vicinity of the Village of Wellesley suitable as sources for a municipal water-supply system.

4. Future Requirements

Sufficient ground water appears to be available to satisfy the individual requirements of the village.

III WATER POLLUTION

1. General

In the absence of communal waste-treatment facilities, the village relies on individual septic tank systems. Most of these systems are reported to function satisfactorily. However, some are connected to storm and private drains which discharge to local watercourses.

2. Industrial Waste Disposal

The solid process wastes from A. W. Jantzi and Sons Limited cider mill and apple butter factory are collected by local farmers. Process wastewater is discharged to the local watercourse. As has been recommended in the past, waste-treatment facilities should be provided.

3. Refuse Disposal

Residents of the village use a refuse disposal site northwest of the village that is supervised by the Township of Wellesley. Details on this site are included in Chapter 16.

4. Surface-Water Quality

The results of storm sewer effluent samples and stream samples taken within the municipality are shown in tables 13-2 and 13-3 respectively.

The analyses of samples of the wastes from the two storm sewers indicate the presence of domestic sewage. The samples taken from the creek downstream of the village outfalls exhibit a deterioration in stream quality, the result of domestic waste discharges within the village.

5. Future Requirements

The discharge of polluting wastes to the local creek requires elimination. In most cases individual correction should be possible. Failing this, the construction of a municipal sewage works should receive consideration.

IV CONCLUSIONS

1. Water Supplies

The present water supplies are considered to be adequate. The quality is generally satisfactory although the iron content is excessive.

2. Pollution Control

Corrective measures are required to eliminate the discharge of polluting wastes to the local watercourse by the local industry and private residences.

TABLE 13-1

VILLAGE OF WELLESLEY - WATER QUALITY OF SUPPLY SYSTEMS

Supply	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Wagner	3	218	238	0.99	1.6	7.8	1.0
Lichti	2	188	236	1.66	1.5	7.9	1.3

Note: the results shown are the averages of the number of samples

TABLE 13-2

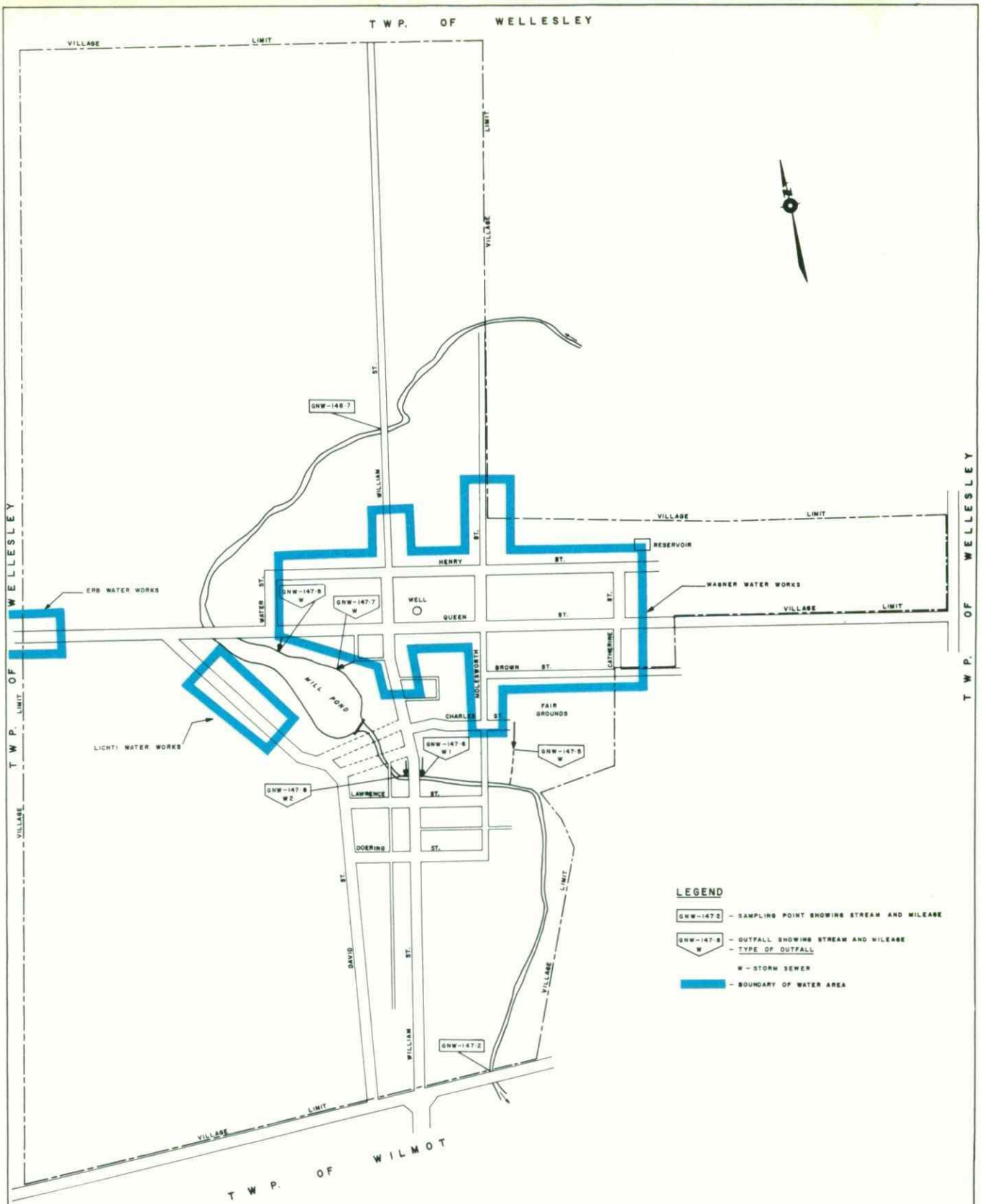
VILLAGE OF WELLESLEY - SAMPLE RESULTS - MUNICIPAL WASTE EFFLUENTS

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GNW 147.5W	5.13.65	At SE Corner of Fair Grounds	6.8	360	8	117,000
GNW 147.6W1	5.13.65	At East Side of William St.	33	490	45	750,000

TABLE 13-3

VILLAGE OF WELLESLEY - SAMPLE RESULTS - WELLESLEY CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
		AT SOUTH BOUNDARY OF VILLAGE				
GNW 147.2	7.21.60	3.7	206	38		330
	8.30.61	4.4	276		10	3,200
	10.10.62	7.0	250		23	9,000
	10. 8.63	4.2	268	21		6,100
	5.13.65	7.8	250	53		4,300
Average		5.4	250	37		
		AT NORTH BOUNDARY OF VILLAGE				
GNW 148.7	7.21.60	2.0	220	10		900
	8.30.61	2.6	328		15	5,400



ONTARIO WATER RESOURCES COMMISSION

VILLAGE OF WELLESLEY
FIGURE 13-1

SCALE 1: 1" = 1000 FEET
DRAWN BY: L.L.S. | DATE: AUGUST, 1965
CHECKED BY: A.C. | DRAWING No: 65-11

CHAPTER 14

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CHAPTER 14

TOWNSHIP OF NORTH DUMFRIES

I GENERAL

The Township of North Dumfries is situated in the south-east corner of the County of Waterloo. Drainage is provided by the Grand River and its tributaries the Nith River and Cedar Creek.

The 1964 assessed population of the township was 3,537. The township is primarily rural.

II WATER SUPPLY

1. General

Water supplies in the Township of North Dumfries are obtained largely from individual wells many of which are of the shallow dug type. There are extensive deposits of sand and gravel to the west of the Grand River which generally yield sufficient water for domestic and farm needs. In recent years, however, in some areas, especially in the vicinity of Galt, a number of the shallow dug wells went dry and had to be deepened.

The bedrock in the western part of the township is composed of the Salina formation which normally yields hard, mineral water. To the east of the Grand River, drilled wells yield water from the overburden and the bedrock.

The only high-capacity wells in the township outside the boundaries of the urban municipalities belong to Best Food Products Limited. These wells are located on the bank of the Nith River north of the Village of Ayr.

2. Potential Additional Supplies

(a) Ground Water

Good-quality ground-water supplies may be obtained from sand and gravel in the overburden and from the bedrock east of the Grand River. In local areas it may be necessary to obtain water from the bedrock west of the Grand River; however, this should be avoided if possible because of the high mineral content of water from that source.

(b) Surface Water

With extensive treatment the Grand and Nith rivers could be utilized as domestic water sources.

3. Future Requirements

Unless an urbanized area is developed in the township a communal water system would be impractical. There appear to be adequate ground-water resources to meet individual requirements.

III WATER POLLUTION

1. General

Private sewage disposal systems are generally in use throughout the township. These units have been installed under the supervision of the Waterloo County Health Unit since its inception.

2. Industrial Waste Disposal

The only industry within the township with an industrial waste that requires treatment is The Best Foods (Canadian) Limited. All wastes are conveyed to a holding pond. No problems of pollution have resulted.

3. Refuse Disposal

Two refuse disposal sites are employed. One is located on Lot 6, Concession 8 and the other is on Lot 33, Concession 7. Both locations are well isolated from watercourses so that pollution problems are not anticipated.

4. Surface-Water Quality

Reference should be made to tables 14-1, 14-2 and 14-3 for the results of surface-water samples obtained from streams within the township.

The average 5-day BOD and the MF coliform count in the Grand River at the Riverside bridge exceed the OWRC objective for stream-water quality. An improvement in quality is noted at the next downstream sampling point.

The analyses of samples obtained from the Nith River and Cedar Creek indicate a generally satisfactory water quality.

5. Future Requirements

Individual disposal systems will continue to meet the requirements for pollution control in the township.

IV CONCLUSIONS

1. Water Supply

The supply is generally adequate and of good quality where water is obtained from the overburden. Bedrock wells in most cases yield hard, mineral water.

2. Pollution Control

There are no known significant sources of pollution in the township. The impairment in water quality noted in the Grand River at the Riverside bridge is the result of waste discharges from upstream municipalities.

TABLE 14-1

TOWNSHIP OF N.DUMFRIES - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Anionic Detergents as ABS (ppm)	Phosphate as PO_4 (ppm)	MF Coliform Count/100 ml	Phenols (ppb)
					AT GLEN MORRIS BRIDGE				
G 82.8	7.10.64	0.9	418	28	20			42	
	8.31.64	2.2	400	23				370	
	10. 5.64	2.9	338	1	6.0			7,100	
	12.15.64	5.5	399	17	16			910	
	1.26.65	3.0	428	5	2.8			2,500	
	2.22.65	3.1	382	6	2.3			248	
Average		2.7	394	13	8.2				
					AT RIVERSIDE BRIDGE				
G 86.5	4.19.61	5.2	280		6			10	
	2.14.63	8.8	484		4.5			6,700	
	8.23.63	1.5	336		2			57,000	
	10.10.63	2.4	382		1.7			6,000	
	12.16.63	5.2	492	7		0.5	1.22	5,700	
	12.17.63	6.6	486	6		0.4	1.54	3,700	
	12.18.63	5.1	456	5		0.3	1.52	4,500	
	1.20.64	9.2	504	10		0.7	2.0		12
	1.22.64	4.2	488	6		0.3	1.24	460	

TABLE 14-1 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Anionic Detergents as ABS (ppm)	Phosphate as PO_4 (ppm)	MF Coliform Count/100 ml	Phenols (ppb)
G 86.5	2.10.64	3.7	454			0.2	0.80	78	
(Cont'd)	2.12.64	4.4	480		1.8	0.3	0.96	1,800	
	7.20.64	3.5	390	26	23			240	
	8.31.64	2.0	374	24				570	
	10. 5.64	2.4	368	7	8.5			11,000	
	12.15.64	7.4	374	23	18			15,000	
	1.26.65	2.8	456	6	2.5			1,200	
	2.22.65	2.7	364	8	2.6			1,800	
Average		4.5	422	11	7.1	0.4	1.40		

TABLE 14-2

TOWNSHIP OF N. DUMFRIES - SAMPLE RESULTS - NITH RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Anionic Detergents as ABS (ppm)	Phosphate as PO_4 (ppm)	MF Coliform Count/100 ml
			AT FALKLAND ROAD DOWNSTREAM FROM AYR					
GN 101.6	7.21.60	6.4	354		6			130
	10.10.62	3.0	434		2.9			1,400
	5.21.63	3.1	352		11.5			1,090
	10. 8.63	1.9	420		2.6			21,000
	12. 2.64	2.2	408		3.3			60
			UPSTREAM FROM AYR (CPR BRIDGE)					
GN 104.1	8.30.61	3.0	442		5			
	12. 2.64	3.0	436		3.8			72

TABLE 14-3

TOWNSHIP OF N. DUMFRIES - SAMPLE RESULTS - CEDAR CREEK

			AT HIGHWAY 97					
GNC 108.7	9.17.63	1.5	478	3				33
	7.14.64	0.2	512	3				280

CHAPTER 15

TOWNSHIP OF WATERLOO

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CHAPTER 15

TOWNSHIP OF WATERLOO

I GENERAL

The Township of Waterloo is situated in the east-central part of the county and surrounds the cities of Kitchener and Waterloo. Development is essentially rural, with the exception of the urbanized lands bordering the cities. Drainage from the township is provided by the Grand River and its tributaries.

The 1964 assessed population of the township was 9,144. There are a few, small industries located in the township.

II WATER SUPPLY

1. General

Water supplies in the Township of Waterloo are obtained largely from individual dug and drilled wells. About 65 per cent of the wells are of the shallow dug type.

Water supply is generally adequate for domestic and farm use. In recent years shortages were experienced especially in the case of dug wells, and many of the shallow wells had to be deepened.

The chemical quality of the ground water is not very good in a number of localities. Excessive hardness and high iron content were reported in the communities of Doon and Bloomingdale.

There are four subdivisions in the township which are served by private, central sources. The bacteriological quality of the water from these systems is monitored by the Waterloo County Health Unit through a program of the collection of monthly samples.

2. Private

(a) Chalon Estates

The Chalon Estates Subdivision is located south of Kitchener on Lot 8 of Bean's Tract. The system is owned by Chalon Estates Incorporated and presently serves seven residences and a church. The subdivision is a registered plan of 126 lots. The water is obtained from an overburden well,

drilled to a depth of 170 feet. The well has an 8-inch-diameter casing and a 15-foot-long 10-slot screen. The well pump is capable of delivering 47 gpm. The water is pumped to a 7,500-gallon underground reservoir from which it is pumped by two 1,000-gph service pumps, operated alternately, to the distribution system. A reservoir is provided primarily for fire protection purposes. In the event of an emergency all three pumps can pump directly to the system, delivering approximately 53 gpm.

The chemical quality of the water is given in Table 15-1. The water is hard and the iron content exceeds the recommended maximum limit of 0.3 ppm. The natural fluoride is less than the optimum level of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(b) Eastmount Subdivision

This water works is owned and operated by Mr. E. McLaughlin and serves approximately 50 homes in the Eastmount Subdivision, Lot 121, G.C.T., on Highway 7 immediately east of the Kitchener city limits. The water supply comes from a 118-foot-deep bedrock well with an 8-inch-diameter casing. The system has a 1,000-gallon pressure tank. A 170-gpm capacity pump delivers the water to the system. There are two fire hydrants on the system. The water works system was laid out in a manner which would allow interconnection with the Kitchener water works system.

The chemical quality of the water is given in Table 15-1. The water is hard, but otherwise chemically satisfactory for domestic consumption. The natural fluoride content of 0.3 ppm is less than the optimum level of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(c) Elroy Acres

The Elroy Acres Subdivision is situated on Lot 115, G.C.T. just south of Breslau and is owned and operated by the subdivider, Mr. E. Brandon. The water works system serves approximately 60 homes. There are two overburden wells supplying the system although Well No.1 is used very sparingly because of the higher hardness of its water. The technical

data of the wells is summarized below.

ELROY ACRES WELL DATA

Well No.	Year Constructed	Depth (ft)	Screen			Yield (gpm)
			Size of Opening	Length (ft)	Diam. (in.)	
1	1957	92	-	-	7	25
2	1961	85	50 slot 15 mesh	5	8	150

There is a 1,000-gallon-capacity pressure tank connected to Well No.2.

The chemical quality of the water is given in Table 15-1. The water, although hard is of excellent chemical quality for domestic consumption. The natural fluoride content is less than the optimum level of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(d) Schweitzer Subdivision

The Schweitzer Subdivision is located on Lexington Crescent on Lot 125, G.C.T. The water works system supplies seven homes from two springs, which flow by gravity to a 12-foot-deep well with a 4-foot-diameter casing. The system is equipped with a 100-gallon-capacity hydropneumatic tank.

The chemical quality of the water is given in Table 15-1. The water is relatively hard, but otherwise it is of excellent chemical quality. There is no natural fluoride content.

The results of bacteriological examinations during the past year indicate that the water from this system may require chlorination.

3. Potential Additional Supplies

(a) Ground Water

Additional ground-water supplies may be obtained from aquifers in the overburden and the bedrock in most areas of the township.

Overburden aquifers are most extensive in the west, and more patchy towards the east.

Bedrock aquifers extend across the whole township but these include the Salina formation which normally yields water with an excessively high mineral content. The Salina formation extends westward from the Preston and Breslau areas, and because of this, good-quality ground water from the bedrock can be located only in the eastern section of the township. In the central portion of the area, near the eastern boundary, normally only small quantities of water can be expected from bedrock wells.

(b) Surface Water

The Grand and Speed rivers could be used as sources for industrial, commercial, domestic and agricultural water supplies; however, extensive treatment would be required for most of these uses.

4. Future Requirements

Individual water requirements can continue to be met by ground-water sources. Sufficient water is available to serve future growth in the areas presently served by the communal systems.

The bacteriological quality of the water serving the Schweitzer Subdivision is doubtful and may require chlorination.

III WATER POLLUTION

1. General

There has been considerable development in the township in the areas bordering the cities of Kitchener and Waterloo. The residential areas employ septic tank and tile bed systems. These units have been installed under the supervision of the Waterloo County Health Unit since its inception in 1961. There are no known pollution problems as a result of the operation of these systems.

2. Industrial Waste Disposal

Forwell Limited - Sand Gravel

Wastewater from the gravel washing operation passes through a settling pond before it is discharged to the Grand River. The degree of treatment has been satisfactory.

Hopewell Farms Limited

Wastes from the steer-feeding operation at the above premises are directed to a storage pond. Contaminated discharges to Hopewell Creek have occurred during previous years, but there have been no recent surface-water pollution problems.

3. Refuse Disposal

An agreement between the township and the City of Kitchener permits the disposal of all refuse at the city's landfill project. A description of the landfill project is included in Chapter 5.

4. Surface-Water Quality

Analyses of surface-water samples obtained from streams within the township are shown in tables 15-2, 15-3 and 15-4. The fact that there are outfalls in the Kitchener-Waterloo area that discharge contaminated wastes is reflected in the water quality exhibited in samples obtained from the Grand River at the Blair bridge.

As discussed in the Kitchener section contaminated discharges within that municipality affect the water quality of Schneider Creek. This fact is exhibited in the downstream samples.

The water quality of Hopewell Creek is satisfactory.

5. Future Requirements

As the areas adjacent to the cities become fully developed it will be advisable to provide a municipal sewage works scheme. The rural areas of the township may continue to be served by individual disposal systems.

IV CONCLUSIONS

1. Water Supply

The quantity of water for individual systems is generally satisfactory throughout the township. However, the chemical quality in a number of localities is unsatisfactory.

The communal systems appear to have satisfactory water supplies from the standpoint of both quantity and chemical quality. The water serving the Schweitzer Subdivision has indicated a doubtful bacteriological quality.

2. Pollution Control

There are no known significant sources of domestic pollution within the township. Problems have been experienced in the past with industrial wastes but no recent problems have occurred.

TABLE 15-1

TOWNSHIP OF WATERLOO - WATER QUALITY OF SUPPLY SYSTEMS

Supply	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Chalon Estates	4	254	205	0.52	3	7.9	0.4
Eastmount Subdivision	2	251	219	0.40	2	7.7	0.3
Elroy Acres							
Well No.1	2	237	254	0.27	3	7.7	0.2
Well No.2	3	181	212	0.17	2	7.9	0.3
Schweitzer Subdivision	3	313	260	0.10	13	7.7	

Note: The results shown are the averages of the number of samples

TABLE 15-2

TOWNSHIP OF WATERLOO - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	Phenols (ppb)	Anionic Detergents as ABS (ppm)	Phosphate as PO_4 (ppm)	MF Coliform Count/100 ml	Temp. (°C)	DO (ppm)
					AT BLAIR BRIDGE						
G 94.3	4.19.61	4.2	278		5				30		
	8.23.61	0.6	314		3				166,000		
	5.16.62	6.0	310		3.6				117,000		
	7.31.62	25.0	400		17						
	10.10.62	7.3	478		0				5,300		
	2.19.63	9.6	460		6.0				65,000		
	10. 9.63	3.9	316		2.1				21,000		
	12.16.63	6.3	460	10			0.5	1.02	1,400		
	12.17.63	4.9	446	7			0.5	0.96	238		
	12.18.63	4.4	426	8			0.2	0.92	70		
	1.20.64	5.4	512	9		15	0.4	1.30	24		
	1.22.64	3.4	484	13			0.3	1.22	70		
	2.10.64	2.1	470		2.1		0.3	0.90	1,900		
	2.12.64	3.7	492		2.0	9	0.2	0.84	500		
	7.20.64	2.1	328	49	32				60	27	6.7
	8.31.64	3.2	430	41					170	23	7.4
	10. 5.64	6.3	360	12	10.0				57,000	11	
	12.15.64	5.3	378	19	18				520	0.5	12.6
	1.26.65	2.7	500	5	2.5				1,200	1.0	14.0
	2.22.65	3.0	372	18	6.0				1,150	0.1	12.8
Average		5.4	411	17	7.0		0.3	1.02			

TABLE 15-2 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
		AT PIONEER TOWER DOWNSTREAM FROM DOON WPCP				
G 97.7	7.31.62	5.0	264		4.5	
	2.12.63	26	586		31	150,000
	6. 6.63					53,000
	10. 9.63	6.4	592	83		3,900
Average		12.5	481		17.8	
		AT HIGHWAY 7				
G 106.8	7.19.60	3.4	232		9	1,930
	4.19.61	4.4	270		5	0
(W. Side)	10. 9.62	5.8	370		2	40,000
(E. Side)	10. 9.62	2.8	310		3.3	46,000
	2.14.63	3.7	394		4.5	9,000
	10. 9.63	2.5	272		3.5	21,000
Average		3.8	308		4.5	

TABLE 15-3

TOWNSHIP OF WATERLOO - SAMPLE RESULTS - SCHNEIDER CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			AT RIVER ROAD				
GS 97.3	7.10.60	5.4	228		17	53,000	
	4.19.61	3.4	450		6	0	
	8.23.61	10	446		2	130	
	10.10.62	6.8	1234		8.5	82,000	
	10. 9.63	4.6	570		6.5	270	
Average		4.2	585		8.0		
			AT OREGON POND DAM				
GS 98.0	8.28.63					53	
	6. 8.64	2.3	858	4		700	
	10. 7.64	2.2	684	1		9,000	8
Average		2.2	771				
			AT WATERLOO TOWNSHIP ROAD 4, (PIONEER VILLAGE)				
GS 99.1	2.28.64	5.1	1,500	24		1,410	10
	6. 8.64	5.0	586	21		250	
	10. 7.64	3.2	842	1		49,000	
	5.13.65	4.4	630	8	8.1		
Average		4.4	890	13			

TABLE 15-4

TOWNSHIP OF WATERLOO - SAMPLE RESULTS - HOPEWELL CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
		AT OUTLET OF CONSERVATION POND AT CONFLUENCE			
GH 107.0	6.17.64	6.4	396	10	1,100
		AT BRESLAU BRIDGE			
GH 107.1	4.10.64				1,100
	6.17.64	2.2	358	0	2,600
	7.15.64	3.4	426	16	320
	5.27.65	0.4	388	2	1,400
Average		2.0	391	6	
		AT HIGHWAY 7			
GH 108.7	4.10.64				410
	7.15.64	1.3	414	18	450
	5.27.65	1.3	386	6	3,200

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CHAPTER 16

TOWNSHIP OF WELLESLEY

I GENERAL

The Township of Wellesley is situated in the northeast area of the county. Development is essentially rural with the exception of the police villages of Linwood and St. Clements and the communities of Hawkesville and Heidelburg.

Drainage from the township is provided by the Nith and Conestogo rivers.

The 1964 assessed population was 4,777.

II WATER SUPPLY

1. General

Water supplies in the Township of Wellesley are obtained mainly by means of individual wells. At several places well owners provide water to adjacent homes. The larger communities, such as Linwood, St. Clements and Heidelberg, are supplied by private, communal water works. The bacteriological quality of the water is monitored by the Waterloo County Health Unit through a program of the collection of monthly samples.

Most of the wells are dug, but there a number of drilled wells. The drilled wells obtain water from both overburden and bedrock aquifers, and generally yield sufficient water for domestic and farm needs. There are many springs in the western part of the township. Water shortages are experienced with shallow dug wells after prolonged dry periods. The deep, overburden wells usually yield very hard water, while the water from the bedrock is less hard, especially in the western half of the township.

2. Police Village of Linwood

More than half of the Police Village of Linwood is supplied by one municipal and two private water works systems. The rest of the village is supplied by dug wells, of which some are overflowing or spring fed.

(a) Linwood Water Works

The Linwood water works was recently purchased by the

Police Village of Linwood from the Canadian Pacific Railway. The system serves approximately 12 homes and has three reservoirs for the purpose of fire protection. The water is supplied by a 216-foot-deep well with a 7-inch-diameter casing. The capacity of the pump is 14 gpm. There is another well connected to the system but it is not in use at present.

The chemical quality of the water is given in Table 16-1. The water is moderately hard and the iron content exceeds the recommended upper limit of 0.3 ppm. The natural fluoride content approaches the optimum level of 1.0 ppm, considered beneficial in the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(b) Luntz Water Works

This system is owned by Mr. A. Luntz and it supplies approximately 14 residences. The source of water is a 240-foot-deep bedrock well with a 5-inch-diameter casing. The pumping rate of the well is 15 gpm. The system is equipped with a 150-gallon pressure tank.

The chemical quality of the water is given in Table 16-1. The water is hard and contains concentrations of iron in excess of the recommended upper limit of 0.3 ppm. The natural fluoride content is less than the level of 1.0 ppm considered beneficial in the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(c) Ogram Water Works

This water works, which is owned by Mr. J. D. Ogram, serves approximately 26 residences in the community. The water is obtained from a 236-foot-deep bedrock well with a 5-inch-diameter casing. The pumping rate is 15 gpm and the system has an 82-gallon pressure tank.

The chemical quality of the water is given in Table 16-1. The analyses indicate that the water is hard and that the iron concentration exceeds the recommended limit of 0.3 ppm. The fluoride content is below the level of 1.0 ppm considered beneficial in the prevention of dental caries.

3. Police Village of St. Clements

The majority of the homes in the Police Village of St. Clements have dug wells. There are four private suppliers in the village; namely, Voison, Strauss, Meyer and Koeble. Each of them supplies up to 10 homes.

4. Other Privately Owned

(a) Erb Water Works

The Erb water works which is owned by Mr. M. Erb, is located in the township immediately west of the Village of Wellesley. It supplies approximately 10 residences in the village and in the township. The water for this system is obtained from a 231-foot-deep bedrock well with a 4-inch-diameter casing. The pumping rate of the well is 20 gpm.

The chemical quality of the water is given in Table 16-1. The analyses indicate a hard water with an iron content that exceeds the recommended limit of 0.3 ppm. The average fluoride content approaches the optimum level of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(b) Heidelburg School Water Works

The Heidelburg School water supply is owned by School Section No. 11, Township of Wellesley, and is located in the Community of Heidelburg on Lot 11, Concession A. Although the system was primarily instituted as a source of water supply for the school, approximately 15 residences have been connected. The water for this system is obtained from a 281-foot-deep bedrock well. The diameter of the casing is 4 inches and the rated capacity of the well is 15 gpm.

The chemical quality of the water is given in Table 16-1. The water is hard and the iron content is slightly in excess of the recommended upper limit of 0.3 ppm. The natural fluoride content is below the optimum level of 1.0 ppm considered beneficial for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory, but early in 1965 a number of unsatisfactory samples were obtained. A more intensified sampling program should be undertaken to determine the quality of this supply.

5. Potential Additional Supplies

(a) Ground Water

Information on potential ground-water supplies for the township is very limited. Certain wells obtain water from the overburden but it appears that there are areas where overburden aquifers are poor or absent.

Ground water from the bedrock aquifers is generally very hard. The Salina formation, which normally yields hard water, forms the bedrock surface in the eastern section of the township. It is overlain by the Bass Island and Bois Blanc formations. Because of this it is likely that bedrock wells will yield less-hard water in the western part of the township provided such wells are not drilled into the Salina formation.

(b) Surface Water

The Nith and Conestogo rivers are the major sources of surface water in the township and could be used for domestic supplies, but extensive treatment would be required.

6. Future Requirements

Individual requirements should continue to be met from ground-water sources. It appears that generally satisfactory water may be obtained from both the overburden and bedrock. However, in some instances water from both of these sources has been extremely hard.

The wells presently serving the communal areas should be able to meet the intended population of these areas.

III WATER POLLUTION

1. General

Sewage disposal throughout the township is generally achieved by the use of septic tank systems. The installation of these systems has been under the supervision of the Waterloo County Health Unit since its inception in 1961. There are no reported pollution problems as a result of the operation of these systems.

2. Industrial Waste Disposal

Wastewater from the J. M. Schneider Limited, Butter and Cheese Division, overflows from a septic tank system to a

low-lying area during the winter months. During frost-free months the wastes are broad-irrigated on adjacent farm lands. Pollution problems have resulted in a local watercourse in the past through improper application of the wastes, but if care is exercised, pollution problems should not be encountered.

3. Refuse Disposal

There are two refuse disposal areas in the township; namely, the east half of Lot 1, Concession 11 and the west half of Lot 10, Township Road 14S at concessions 3 and 4. Both refuse sites are the open-face type and are sufficiently isolated to prevent any possibility of contamination of a watercourse.

4. Future Requirements

Individual waste disposal systems will continue to meet the requirements of pollution control in the township.

IV CONCLUSIONS

1. Water Supply

The supply is generally adequate and of good quality. However, in some areas the water is extremely hard from both the overburden and the bedrock.

A sampling program is required to determine the bacteriological quality of the Heidelberg School water supply.

2. Pollution Control

The only known significant pollution problem in the township has resulted from the disposal of industrial wastes. More care is required to ensure that future pollution problems do not result from this source.

TABLE 16-I

TOWNSHIP OF WELLESLEY - WATER QUALITY OF SUPPLY SYSTEMS

Supply	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Linwood Municipal	2	145	205	0.68	45	7.9	0.7
M. Erb	4	200	238	0.63	1	7.9	0.6
Heidelburg School	1	280	230	0.35	6	7.7	0.3
A. Luntz	2	193	222	0.91	4	7.5	0.5
J. D. Ogram	2	192	223	1.03	3	7.7	0.5

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CHAPTER 17

TOWNSHIP OF WILMOT

I GENERAL

The Township of Wilmot is located in the southwest area of the county. Development is essentially rural with the exception of the Police Village of Baden, and the communities of New Dundee and St. Agatha.

Drainage from the township is provided by the Nith River and its tributaries.

The 1964 assessed population was 5,874. The township supports a few industries which are engaged in the processing of poultry and milk products.

II WATER SUPPLY

1. General

Water supplies in the Township of Wilmot are obtained mainly by means of individual wells. These are either dug, drilled or bored. Most of the wells in the eastern part of the township obtain water from overburden aquifers. In the western section of the township overburden aquifers appear to be poor or absent and most of the wells obtain water from bedrock aquifers. In general, the chemical quality of water from the overburden aquifers is preferable to that from the bedrock aquifers.

The wells are generally adequate for domestic and farm needs, although supplies from shallow dug wells may be insufficient after periods of below-normal precipitation. In recent years many dug wells went dry, especially in the eastern half of the township.

There are several residential areas within the township that have developed communal water systems. Three of these serve more than five residences each. The bacteriological quality of the water is monitored by the Waterloo County Health Unit through a program of the collection of monthly samples.

2. Police Village of Baden

There is no municipal or private water works system in the Police Village of Baden. Water is obtained from

individual wells. There are two flowing wells and one high-capacity well in the community. The high-capacity well is apparently not in use.

3. Private

(a) Hamacher Water Works

The Hamacher water works system is located in New Dundee and serves approximately 13 homes. The source of water is a 213-foot-deep bedrock well with a 6-inch-diameter casing. The system is equipped with a 200-gallon pressure tank. The pumping rate is 14 gpm.

The chemical quality of the water is given in Table 17-1. The water is extremely hard and has an excessive iron content. The natural fluoride content is less than the optimum concentration of 1.0 ppm deemed desirable for the prevention of dental caries.

The bacteriological quality of the water has been satisfactory.

(b) Hannon Water Works

The Hannon water works system is located in St. Agatha and serves approximately 18 homes. The water is supplied by a 166-foot-deep overburden well which has a 6-inch-diameter casing and a 6-foot copper screen. The rated capacity of the well is 12 gpm. The water works system has a 275-gallon-capacity tank.

The chemical quality of the water is given in Table 17-1. The water is hard and has no natural fluoride content. The iron content is slightly in excess of the recommended upper limit of 0.3 ppm.

The bacteriological quality of the water has been satisfactory.

(c) Schwartzentruber Water Works

The Schwartzentruber Subdivision is located on Lot 7, north of Erb's Road, immediately adjacent to the community of St. Agatha. The water works system had 18 services at the end of 1964. The source of water is a 172-foot-deep overburden well with an 8-inch-diameter casing and 10-foot-long, 30- to 50-slot screen. The water system is equipped with four, 300-gallon-capacity tanks. The recommended pumping rate of the well is from 300 to 500 gpm, but a pump capable of delivering

30 gpm supplies the water to the system.

The chemical quality of the water is given in Table 17-1. Other than the fact that the water is hard the chemical quality is quite satisfactory for domestic consumption. The iron concentration is less than the recommended upper limit of 0.3 ppm. There is no natural fluoride content.

The bacteriological quality of the water has been satisfactory.

4. Potential Additional Supplies

(a) Ground Water

The kame moraine deposit in the eastern section of the township appears to be the most favourable aquifer for the development of water supplies. It is likely that high capacity wells could be constructed in this deposit. It extends westward as far as Baden and it is, therefore, a potential source of water supply for the police village. The overburden in the western section of the township is composed largely of till and is less favourable as a potential source of supply. However, water may be obtained locally from interbedded sand and gravel deposits and spillway deposits. Water from these deposits can be extremely hard.

The bedrock aquifers are a potential source of water supply, although the water may be extremely hard. The hardness of water from rock wells is greatest in the eastern section of the township where the Salina formation forms the bedrock surface.

A ground-water survey and a test-drilling program would be needed to locate the more favourable sites for municipal wells.

(b) Surface Water

The Nith River and Alder Creek are the major surface-water sources in the township. They could be used for domestic water supplies but the waters would require extensive treatment before use.

5. Future Requirements

Individual water requirements should continue to be met by ground-water sources. Sufficient water is available to serve future growth in the areas presently served by the

communal systems. It appears that generally satisfactory water may be obtained from both the overburden and bedrock. However, in some instances water from these sources has been extremely hard.

The wells presently serving the communal areas should be able to meet the intended population of these areas.

III WATER POLLUTION

1. General

Private sewage disposal systems are used throughout the township. Since the inception of the Waterloo County Health Unit in 1961, these systems have been installed under its supervision. Owing to lack of available space and adverse soil conditions many septic tank systems in the Police Village of Baden are not functioning properly. As a result, untreated or partially treated wastewater is discharged to Baden Creek at a number of points throughout the village.

2. Industrial Waste Disposal

(a) Baden Cheese Limited

Untreated wastewater from the Baden Cheese Limited is discharged to Baden Creek via the Snyder Road storm sewer. If a sewage works is not constructed in the immediate future in Baden, a method of adequately treating the waste should be investigated by the industry.

(b) New Dundee Co-Operative Creamery Limited

Wastewater is directed to property 1 mile east of the plant where it is disposed of by a spray irrigation system during the mild weather. During the winter months the wastes are directed to a total retention pond. There are normally no pollution problems as a result of the industrial waste disposal. Occasionally, milk wastes are discharged to a local watercourse due to the faulty operation of the plant's process equipment. Steps are being taken to prevent these discharges.

(c) Tend-R-Flesh Limited

This poultry processing plant uses three waste stabilization ponds which are operated in series. Excessive organic loadings being placed on the system have resulted in inadequate waste treatment and pollution of Alder Creek. It has been recommended that the treatment facilities be improved.

3. Refuse Disposal

Residents in the north part of the township dispose of refuse at the City of Waterloo landfill located on the north half of Lot 2 NER. This site is discussed in Chapter 6. The south half of the township use an open-face dump located in a former gravel pit on the north half of Lot 4, Concession 3, Block A. There have been no pollution problems as a result of this operation.

4. Surface-Water Quality

Analyses of surface-water samples obtained from streams and outfalls within the township are shown in tables 17-2, 17-3, 17-4 and 17-5. Gross contamination is exhibited in the analyses of effluent samples obtained in Baden. The analyses were indicative of domestic sewage.

Satisfactory quality is exhibited in results of samples obtained from the Nith River. Adverse water quality is noted in samples from Alder Creek downstream from New Dundee and Petersburg, as a result of industrial waste discharges. Pollution is exhibited in some of the samples obtained from Baden Creek immediately downstream from Baden. This may be attributed to the numerous domestic wastewater outfalls within that community.

5. Future Requirements

The rural areas of the township may continue to be served by individual disposal systems. A municipal sewage works should be constructed in the Police Village of Baden. Further study of industrial waste treatment at Baden Cheese Limited and Tend-R-Flesh Limited will be required.

IV CONCLUSIONS

1. Water Supply

The quantity of water for individual systems is generally satisfactory throughout the township. However, in some areas the water is extremely hard from both the overburden and the bedrock.

2. Pollution Control

Pollution problems exist in the Police Village of Baden. The limited size lots and poor soil conditions make the use of individual disposal systems difficult. A communal sewage

works system should be provided.

Baden Cheese Limited should either enter into a joint waste-treatment scheme with the municipality or provide separate waste treatment facilities.

Improvements are required for the industrial waste treatment facilities at Tend-R-Flesh Limited.

TABLE 17-1

TOWNSHIP OF WILMOT - WATER QUALITY OF SUPPLY SYSTEMS

Supply	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Hamacher	3	1,425	151	6.0	3	7.3	0.6
Hannon	2	264	238	0.33	10	7.6	0.0
Schwartzentruber	3	272	235	0.19	11	7.6	0.0

TABLE 17-2

SAMPLE RESULTS - STORM AND WASTE WATER OUTLETS

POLICE VILLAGE OF BADEN

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GNB 129.7W	Snyder's Rd. Storm Sewer	12.14.62	440	750	151	1,530,000
		9.17.64		Insufficient Flow to Sample		
GNBN 129.7W	At Snyder's Rd. and Railroad	12.14.62	26	1,070	28	165,000
		9.17.64	305	854	160	50,000,000
GNB 128.8W	At Charles St.	12.14.62	70	1,274	123	6,000,000
		9.17.64	380	1,622	558	580,000,000
GNB 129.1W	At Tannery St.	12.14.62	6.2	406	12	25,100
		9.17.64	2.4	300	11	97,000
GNB 129.0W	At William St.	12.14.62	100	950	300	2,700,000
		9.17.64	1,000	2,118	938	410,000,000

TABLE 17-3

POLICE VILLAGE OF BADEN - SAMPLE RESULTS - BADEN CREEK AND TRIBUTARY

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Temp. (°C)	DO (ppm)
			AT HIGHWAY 7 AND 8, DOWNSTREAM FROM BADEN					
GNB 128.8	12.14.62	4.2	346	24		27,000		
	7.21.64	2.0	380	53	31	350	25	8.6
	9. 1.64	1.4	368	10	6.5	770	16	5.0
	9.17.64	1.4	300	17		7,000		
	10. 5.64	2.3	338	21	17	260	9	5.2
	12.15.64	2.5	358	14	10	10,700	1.0	12.0
	1.28.65	6.0	434	98	12		1.0	14.8
	2.22.65	1.7	328	15	2.8		12	0.2
Average		2.7	356	31	13			
			AT BRUBACHER STREET					
GNB 129.7	12.14.62	2	330	4		5,400		
	9.17.64	1	330	30		19,000		
			NORTH BRANCH, UPSTREAM FROM DRAIN DISCHARGE AT SNYDER ROAD					
GNBN129.7	9.17.64	0.5	278	10		470		

TABLE 17-4

TOWNSHIP OF WILMOT - SAMPLE RESULTS - ALDER CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
			AT HIGHWAY 97			
GNA 109.6	10.9.62	2.8	446		7.5	46
	10.8.63	1.1	528		1.8	1,900
	10.6.64	2.4	542			112
Average		2.1	505		4.6	
			AT CONCESSION ROAD BRIDGE, 0.25 MILE BELOW NEW DUNDEE			
GNA 111.8	7.20.60	4.8	418		7	9,000
	10.10.62	7.6	662		2.6	33,000
	10. 8.63	1.5	462		2.1	2,200
	10. 6.64	1.6	442	1		144
Average		3.9	496		3.9	
			AT MILL POND DAM, NEW DUNDEE			
GNA 113.0	7.20.60	3.6	260		12	390
	9.22.61					10

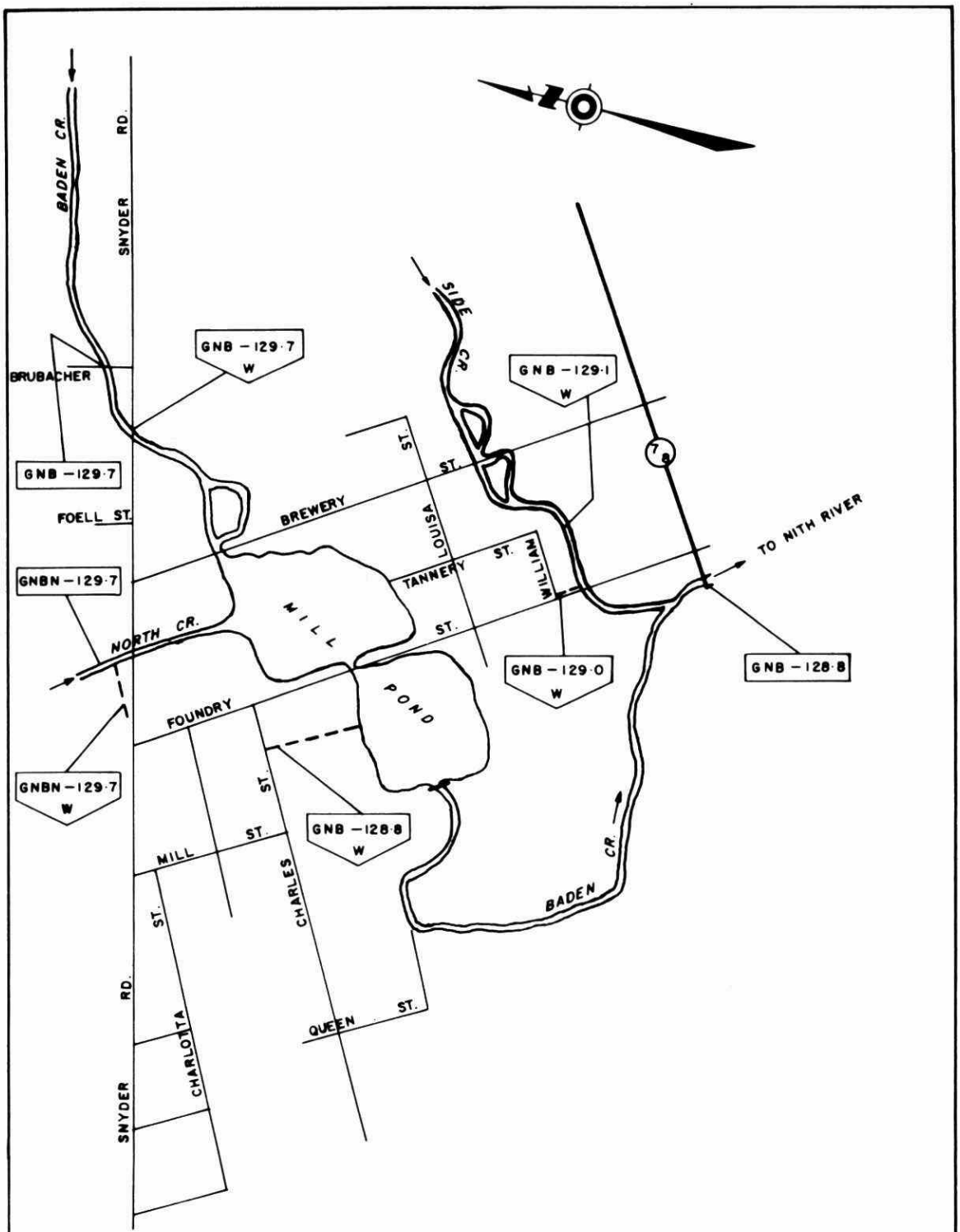
TABLE 17-4 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
		AT FIRST CONCESSION ROAD ABOVE NEW DUNDEE				
GNA 114.0	7.20.60	2.4	262		5	900
	9.22.61	3.2	312		2	90
	10. 6.64	1.4	332	1		90
	3. 4.65					520
Average		2.3	302		3	
		AT MANNHEIM				
GNA 117.4	3.25.64	4.6	374	32		4,200
	10. 8.63	5.2	492	12		3,600
Average		4.9				
		AT PETERSBURG ROAD				
GNA 120.2	7.20.60	2.4	408		3	1,100
	10. 9.62	4.1	662		2.6	18
	8.27.63	0.8	498	12		2,300
	10. 3.63	41.0	590	64		83,000
	3.25.64	8	474	34		890
	10. 6.64	13.0	588	16		340
	10.23.64	25.0	598	22		700
Average		12.0	545	29	2.8	

TABLE 17-5

TOWNSHIP OF WILMOT - SAMPLE RESULTS - NITH RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
		AT CONCESSION ROAD BRIDGE - HAYSVILLE				
GN 124.2	7.21.60	3.2	282	18		820
	8.30.61	4.0	342		10	4,700
	10. 9.62	3.6	386		8	340
Average		3.6	337		9	
	AT FIRST BRIDGE DOWNSTREAM FROM NEW HAMBURG LAGOON OUTFALL					
GN 127.3	10. 8.63	3.1	320	11		1,000
	AT HWY 7 AND 8 BY-PASS					
GN 130.1	7.21.60	2.6	322	36		840
	8.30.61	2.6	302		8	428
	10. 9.62	3.2	334		8.5	1,200
	10. 8.63	2.5	304	20		460
Average		2.7	315	28	8	



LEGEND

GNB – 129·7 – SAMPLING POINT SHOWING STREAM AND MILEAGE

GNB – 129·7 W – OUTFALL SHOWING STREAM AND MILEAGE
– TYPE OF OUTFALL
W – STORM SEWER

– – – – – OPEN DITCH

ONTARIO WATER RESOURCES COMMISSION

POLICE VILLAGE OF BADEN

FIGURE 17–1

SCALE: 350 0 350 700 FEET	
DRAWN BY: L.L.B.	DATE: JUNE, 1966
CHECKED BY:	DRAWING No. 66 – 33

CHAPTER 18

TOWNSHIP OF WOOLWICH

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CHAPTER 18

TOWNSHIP OF WOOLWICH

I GENERAL

The Township of Woolwich is located in the northwest area of the county. Development is essentially rural with the exception of the police villages of Conestogo and St. Jacobs and the communities of Winterbourne and Floradale.

Drainage from the township is provided by the Grand River and its tributaries.

The 1964 assessed population of the township was 5,490. There are a few small industries located in the township.

II WATER SUPPLY

1. General

Water supplies for domestic and farm use in the Township of Woolwich are obtained largely from individual wells, except in a more densely populated area southwest of the Town of Elmira. That area is supplied by an extension of the Elmira municipal system.

There are a number of flowing wells in the township. The flowing wells seem to be concentrated on the west side of the Grand River north of Conestogo and in St. Jacobs. Most of these wells terminate in the bedrock.

Water supplies from drilled wells are generally adequate for domestic and farm needs but dug wells are occasionally inadequate.

In the northern part of the township almost all of the wells are of the deep, drilled type. In many cases they supply more than one home.

2. Police Village of Conestogo

There is no municipal or private water works system in the Police Village of Conestogo. All the older homes are supplied by dug wells. Because of insufficient water supplies in drier seasons, many wells have had to be deepened or new wells had to be drilled. In many instances water from drilled wells has a high iron content.

3. Police Village of St. Jacobs

The Police Village of St. Jacobs does not have a municipal water works system. Water for domestic purposes is obtained from four communal wells and 170 individual wells, and for fire-fighting purposes from the Conestogo River. The river water is pumped through a 6-inch supply main to a small distribution system in the business section of the village.

There are 164 dug wells in the village and a recent survey indicated that 62 per cent of the wells yield water that is bacteriologically unsatisfactory.

Consideration is now being given to the construction of a municipal water works system.

Good Subdivision

The Good Subdivision is supplied by water from a system owned by Mr. A. Good. The water is supplied from a 125-foot-deep overburden well which has an 8-inch-diameter casing with an 8-foot stainless steel screen at the bottom. The capacity of the pump is 40 gpm. The system is equipped with an 80-gallon pressure tank. This well was constructed in 1964 to replace a former well which had been found to be bacteriologically unsatisfactory.

The chemical quality of the water is given in Table 18-1. The chemical-quality determinations indicated a very hard water with an iron content which exceeds the recommended upper limit of 0.3 ppm. It is noted that the natural fluoride content equals the optimum level of 1.0 ppm, deemed desirable for the prevention of dental caries. Based on the samples taken since the new well has been in service, the bacteriological quality is satisfactory.

4. Privately Owned

Martin's Grove Mobile Home Park

This water works system serves approximately 30 mobile homes. The source of the water is a 135-foot-deep, 8-inch-diameter overburden well. The rated capacity of the well is 25 gpm. The system has a 65-gallon pressure tank.

The chemical quality of the water is given in Table 18-1. The water is extremely hard and contains excessive concentrations of iron. The recommended upper limit for iron concentration in the water is 0.3 ppm.

The bacteriological quality of the water has been satisfactory.

5. Potential Additional Supplies

(a) Ground Water

Ground-water supplies may be obtained from aquifers in both the overburden and the bedrock.

Present information indicates that the better aquifers in the overburden are restricted to the southern and western sections of the township in the vicinity of Conestogo and south of St. Jacobs and in the area surrounding Elmira.

Supplies of good-quality ground water may be obtained from the bedrock in the eastern section of the township. Ground-water supplies from the bedrock in the western section of the township may be highly mineralized especially in and north of Conestogo.

Ground-water surveys and test-drilling programs would be required to locate the more favourable sites for municipal wells.

(b) Surface Water

The Grand and Conestogo rivers and Canagagigue Creek are the major surface-water sources in the township. The waters of these streams could be further utilized for industrial and domestic water supplies; however, extensive treatment would be required.

6. Future Requirements

In view of the large number of wells in the Police Village of St. Jacobs which yield a bacteriologically unsatisfactory water the need for a municipal water supply system is indicated.

Water supplies from drilled wells in the remainder of the township should be capable of continuing to supply adequate quantities of water for domestic and farm use.

III WATER POLLUTION

1. General

Private septic tank and tile bed systems are generally used throughout the township. These installations have been

supervised by the Waterloo County Health Unit since its inception in 1961. Sewage disposal problems have been reported in the Police Village of St. Jacobs where many of the premises discharge domestic wastes to the storm drains which discharge to the Conestogo River.

2. Industrial Waste Disposal

(a) Canada Felting Company Limited

This industry is engaged in the production of felt and felt products. The effluent to the river has a depressed pH as sulphuric acid is used in the process. Either some form of individual treatment should be provided or it should be ascertained whether the wastewater could be included in the proposed sewage works for St. Jacobs.

(b) Gordon Young (Elmira) Limited

Wastes from the above rendering plant are discharged untreated to the Canagagigue Creek. Pre-treatment facilities are scheduled for installation during May 1965. Following this, engineering studies will be carried out to decide on a feasible method of final treatment.

(c) St. Jacobs Canning Company Limited

Untreated wastewater from the above apple juice cannery is discharged to the Conestogo River. Effluent samples indicate that gross contamination is thereby being discharged at this point. A consulting engineer has been retained to determine a suitable method of waste treatment.

(d) St. Jacobs Creamery Limited

Treatment is not provided for wastewater from the above plant. Recommendations have been made to the industry to provide treatment on an individual basis. Consideration should also be given to including this firm's wastewater in the proposed St. Jacobs sewage works.

(e) St. Jacobs Dairy

Process wastewater discharges to the Church Street storm sewer. Owing to lack of available land, treatment on an individual basis is not practical. Provision should therefore be made to include this firm's wastewater in the proposed St. Jacobs sewage works.

3. Refuse Disposal

There are two open-face refuse disposal areas within the township. One is at the north end on the north half of Lot 62, German Company Tract, Township Road No.7. It is located on a hillside and is isolated from any watercourse. The second site is on the south half of Lot 33, German Company Tract, south of Conestogo. It is located in flats north of Conestogo River in an area isolated from buildings. Pollution problems have not been encountered as a result of this operation.

4. Surface-Water Quality

Analyses of samples obtained from wastewater effluents and streams within the township are shown in tables 18-2 to 18-5.

The outfall sample analyses at St. Jacobs show gross contamination, indicative of domestic and other organic wastes.

Stream samples obtained from the Grand and Conestogo rivers in the township indicate a satisfactory water quality. Comparison of analyses of samples obtained from Canagagigue Creek approximately 1 mile upstream from Elmira with those taken downstream from the town reveals a marked deterioration in the water quality.

5. Future Requirements

The rural areas of the township may continue to be served by individual disposal systems. A municipal sewage collection and treatment system will be required in St. Jacobs.

Pollution control measures are required at the five industries discussed earlier in the chapter.

IV CONCLUSIONS

1. Water Supply

The water supply is generally adequate and of good quality in most areas of the township. However, there are a large number of wells which produce bacteriologically unsatisfactory water in the Police Village of St. Jacobs.

2. Pollution Control

Pollution problems exist in the Police Village of St. Jacobs. Many of the private homes as well as four industries

discharge wastes to the Conestogo River. A municipal sewage works would correct the condition.

Pollution of Canagagigue Creek results from the discharge of industrial wastes.

No pollution problems result from the operation of the municipal refuse disposal sites.

TABLE 18-1

TOWNSHIP OF WOOLWICH - WATER QUALITY OF SUPPLY SYSTEMS

Supply	No. of Samples	Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Iron as Fe (ppm)	Chloride as Cl (ppm)	pH at Lab	Fluoride as F (ppm)
Good Subdivision	1	860	203	1.5	10	7.4	1.0
Martin's Grove Mobile Home Park	3	1,663	201	1.5	14	7.4	

TABLE 18-2

TOWNSHIP OF WOOLWICH - POLICE VILLAGE OF ST. JACOBS -

SAMPLE RESULTS - STORM AND WASTEWATER OUTLETS

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GC 121.8D1	10.29.57	Church St. Storm Sewer	102	674	30	100,000
	6. 5.61		12	488	28	290,000
	5.19.64		19	331	22	970,000
GC 122.2W1	10.29.57	Storm Sewer Outlet at	1,780	3,500	130	10
	6. 5.61	Water and Albert	135	1,250	138	22,400,000
	5.19.64	Streets	18	508	22	620,000
GC 122.25P	10.29.57	Private Drain Outlet	26	536	30	10
	6. 5.61	(Dominion Hotel)	39	472	36	14,000,000
	5.19.64			Insufficient Flow		
GC 122.25PI	10.29.57	Private Drain Outlet	65	880	50	0
	6. 5.61	(Canada Felting Company)	6.8	334	32	11,000,000
	5.19.64		11	396	14	180,000
	5.27.65		12	320	21	900,000
GC 122.27W	10.29.57	King St. Storm Sewer	43	904	40	0
	6. 5.61		16	930	32	50,000
	5.19.64		47	1,090	40	11,900,000

TABLE 18-2 (CONT'D)

Sampling Point No.	Date	Location	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	MF Coliform Count/100 ml
GC 122.3W	10.29.57	Isabella St. Storm	103	864	94	1,000,000
	6. 5.61	Sewer	980	1,502	444	157,000,000
	5.19.64		3,100	3,596	1,132	107,000,000
GC 122.2I	10.29.57	St. Jacobs Creamery	1,032	3,482	1,482	0
	6. 5.61	Effluent		Insufficient Flow to Sample		
	5.19.64			"	"	"

TABLE 18-3

TOWNSHIP OF WOOLWICH - SAMPLE RESULTS - GRAND RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml	Phenols (ppb)
			GRAND R. AT BRIDGE IN CONESTOGO				
G 118.4	7.19.60	3.2	204	28		29,000	
	4.10.61	3.3	270		4	10	
	8.22.61	1.0	266		3	280	
	10. 9.62	3.0	258		7.5	100	
	10. 8.63	2.0	260		1.4	30	10
Average		2.5	252		4.0		

TABLE 18-4

TOWNSHIP OF WOOLWICH - SAMPLE RESULTS - CONESTOGO RIVER

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity Units	MF Coliform Count/100 ml
		AT CONFLUENCE, CONESTOGO				
GC 118.4	4.19.61	3.3	270		4	10
	10. 9.62	2.2	282		2.1	100
	AT SIDEROAD 0.75 MILE UPSTREAM FROM JUNCTION WITH GRAND R.					
GC 118.9	4.19.61	3.4	358		8	0
	10. 9.62	3.0	258		7.5	800
	2.13.63	5.0	460		5.5	2,070
	10. 8.63	1.1	234		7.0	740
Average		3.1	328		7.0	
	AT COUNTY RD. BRIDGE 1.5 MILES DOWNSTREAM FROM ST. JACOBS					
GC 119.9	10.8.63	1.5	234		8.0	9,000
	OPPOSITE ISABELLA ST., ST. JACOBS					
GC 122.4	7.20.60	0.6	260		10	200
	4.19.61	3.0	280		9	20
	8.22.61	2.8	254		11	70
	10. 8.63	1.8	262		11.5	430
Average		2.0	264		10	

TABLE 18-5

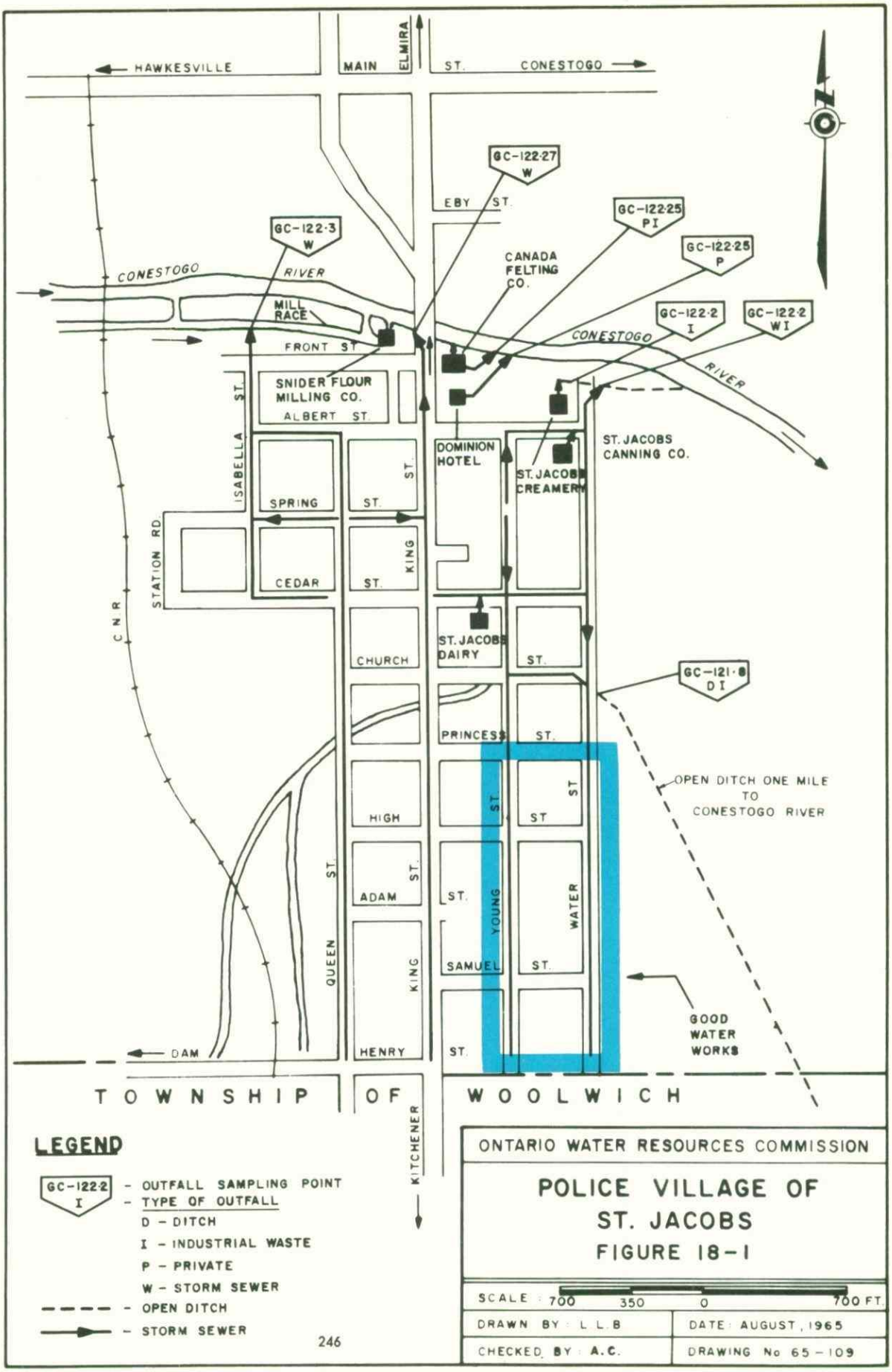
TOWNSHIP OF WOOLWICH - SAMPLE RESULTS - CANAGAGIGUE CREEK

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	COD (ppm)	pH at Lab	Phenols (ppb)	Ether Solubles (ppm)	Iron as Fe (ppm)	MF Coliform Count/100 ml	Temp. (°C)	DO (ppm)
				AT COUNTY RD. 22, (CONESTOGO RD.)								
GCG 123.9	2.12.64	1,100*	15,142	860	2,600	2.8	80,000	270	750		0.2	6.75
	3.19.64	3.6	532	1	24	7.6	30	0.0	0.27		0.2	11.3
	4.15.64	2.4	500	9	32	8.1	45	Trace	0.26		6.8	9.65
	5.12.64	5.4	734	3	36	8.0	40	0	1.07		12.2	8.9
	7.15.64	6.8	690	12	45	8.3	90	3	0.82			
Average		4.5	659	6	34	6.9	51		0.6			
				1 MILE DOWNSTREAM FROM ELMIRA								
GCG 125.6	8.22.61	15	638		4					7,300		
	10. 9.62	31	1,052		10		1,100			1,400,000		
	2.19.63	40	1,026		11		1,500			35,000		
	7. 3.63	26	1,272		20					15,000,000		
	10. 9.63	122	1,896		20		4,500			1,100		
	1.20.64	45	972	14			1,500					
	2.12.64	28	970	10	50	7.5	400	0	0.75		1.8	7.95
	3.19.64	9	574	2	44	7.4	70	0	0.3		0.2	10.8
	4.15.64	3.8	462	15	36	7.9	50	0	0.35		7.4	8.38
	5.12.64	15	840	3	56	7.5	300	0	0.54		13.5	NIL
	7.15.64	11	514	14	53	8.3	70	3	0.62			
Average		31	760	9	30	7.7	1,054		0.51			

TABLE 18-5 (CONT'D)

Sampling Point No.	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	COD (ppm)	pH at Lab	Phenols (ppb)	Ether Solubles (ppm)	Iron as Fe (ppm)	MF Coliform Count/100 ml	Temp. (°C)	DO (ppm)
			600 FT. DOWNSTREAM OF G. YOUNG OUTFALL									
GCG 128.0	7. 3.63	5.8	432							280,000		
	6.23.64	12.0	286	10						610,000		
			AT CONCESSION RD. 1 MILE UPSTREAM FROM ELMIRA									
GCG 128.6	8.22.61	1.2	300							100		
	10. 9.62	2.2	294							146		
	10. 9.63	1.7	300							174		
	2.12.64	28.0	470	19	56	7.8	7		0.44			
	3.19.64	1.0	306	8	12	8.0	20	0	0.3		0	12.3
	4.15.64	0.8	366	62	24	8.2	8	2	0.6		8	11.15
	5.12.64	1.2	288	4	20	8.2	25	0	0.24		12.2	8.75
	6. 9.64	1.3	286	11						3,800		
	6.23.64	1.4	262	11						1,200		
	7.15.64	1.3	330	30	26	8.4	12	2	1.08			
Average		3.9	320	20	27	8.1	14	2	0.5			

* omitted from average



LEGEND

GC-122-2 I – OUTFALL SAMPLING POINT – TYPE OF OUTFALL

D – DITCH

I – INDUSTRIAL WASTE

P – PRIVATE

W – STORM SEWER

– – – – OPEN DITCH

——→ STORM SEWER

ONTARIO WATER RESOURCES COMMISSION

POLICE VILLAGE OF ST. JACOBS

FIGURE 18-1

SCALE: 700 350 0 700 FT.	
DRAWN BY: L.L.B	DATE: AUGUST, 1965
CHECKED BY: A.C.	DRAWING No. 65-109

ABBREVIATIONS AND SYMBOLS

Engineering Terms

ABS	alkyl benzene sulfonate
avg.	average
BOD	biochemical oxygen demand
COD	chemical oxygen demand
cfs	cubic feet per second
ft	foot, feet
gal	gallons (Imperial unless otherwise noted)
gpcpd	gallons per capita per day
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
in.	inch
lb	pound
MF	membrane filter
mgd	million gallons per day
mi	mile
ml	millilitre
pH	hydrogen iron concentration
ppb	parts per billion
ppm	parts per million
sq ft	square feet
sq mi	square miles

Proper Names

CNR	Canadian National Railways
OWRC	Ontario Water Resources Commission

Miscellaneous

@	at
Commission	Ontario Water Resources Commission
Cr.	Creek
Co.	Company
Conc.	Concession
cont'd	continued
Hwy.	Highway
Inc.	Incorporated
Ltd.	Limited
max.	maximum
min.	minimum
Mfg.	Manufacturing
No.	number

ABBREVIATIONS AND SYMBOLS

Miscellaneous (Cont'd)

red.	reduction
Rd.	Road
STP	Sewage Treatment Plant
St.	Street
susp.	suspended
Twp.	Township
WW	Water Works
WPCP	Water Pollution Control Plant
>	greater than
<	less than
%	per cent

EXPLANATION AND SIGNIFICANCE OF LABORATORY ANALYSES

A. BACTERIOLOGICAL EXAMINATION

Bacteriological examinations were performed on samples from water supplies, streams and outfalls. The Membrane Filter Technique was used to obtain a direct enumeration of coliform organisms. These organisms are normal inhabitants of the intestines of man and other warm blooded animals. They are always present in large numbers in sewage and are generally minimal in other stream pollutants.

The results of the examinations are reported as "MF Coliform Count per 100 ml".

The Commission's objective for stream sanitation is a coliform density of not greater than 2,400 organisms per 100 ml.

B. STREAM AND OUTFALL SAMPLES

The chemical analyses performed on stream and outfall samples include determinations for biochemical oxygen demand, suspended solids, turbidity, and in some instances, pH, alkyl benzene sulfonate (ABS) and others.

BIOCHEMICAL OXYGEN DEMAND (BOD):

Biochemical Oxygen Demand is reported in ppm and is an indication of the amount of oxygen required for the stabilization of decomposable organic matter present in sewage, polluted waters or industrial wastes. The completion of the laboratory test requires 5 days under the controlled incubation temperature of 20°C.

The acceptable limit for stream-water quality is 4 ppm.

SOLIDS:

The laboratory carries out tests to determine the total and suspended solids in a sample. The value for dissolved solids is determined by taking the mathematical difference between the total and suspended solids.

The concentration of suspended solids, expressed in ppm, is generally the most significant of the solids analyses in regard to stream-water quality. The effects of suspended

solids in water are reflected in difficulties associated with water purification, deposition in streams and injury to the habitat of fish.

Where suspended solids values approach 20 ppm or less, laboratory difficulties are experienced and, excepting the samples from sewage treatment works, the values of suspended matter are usually determined as turbidity.

TURBIDITY:

Turbidity is caused by the presence of suspended matter such as clay, silt, finely divided organic matter, plankton and other microscopic organisms in water. It is an expression of the optical property of a sample and results are reported in "Turbidity Units" (Jackson Scale).

pH:

The pH is an index of the acidity or alkalinity of the solution as represented by the instantaneous hydrogen ion concentration. The practical pH scale extends from 0, very acidic, to 14, very alkaline, with the middle value of pH 7 corresponding to exact neutrality (at 25°C). The objectives for surface-water quality as adopted by the OWRC suggest that the pH of the waters following initial dilution, should not be less than 6.7 nor greater than 8.5.

ABS (ALKYL BENZENE SULFONATE):

The alkyl benzene sulfonate portion of the anionic detergents is reported in ppm. The test is generally employed to indicate the presence of illegal discharge of wastewater to storm drains.

The popular use of synthetic detergents for general cleaning purposes has resulted in the incidence of residual ABS in streams. As an objective, the ABS concentration should not exceed 0.5 ppm in water used for domestic purposes.

ETHER SOLUBLES:

Ether solubles in a waste discharge indicate the presence of oil or grease in water as an emulsion from industrial wastes or similar sources, or a light petroleum fraction in solution.

PHENOLS:

The phenolic compounds, collectively referred to as phenols, are those hydroxy derivatives of benzene or its condensed nuclei, which are determined by the Gibbs Method with modifications. The results are usually reported in ppb.

Phenols are present in waste flows from many industrial processes. Dependent on the concentration, the presence of these materials may be toxic to fish or may taint the flesh of fish. Phenols in very minute concentrations will combine with chlorine to produce intense tastes and odours which are variously described as medicinal, chemical or iodoform.

As an objective, the concentration of phenols should not exceed 5 ppb at any point in receiving waters subsequent to initial dilution. Phenols in discharges from outfalls should not exceed 20 ppb.

CYANIDES:

Cyanides are probably the most toxic substances in industrial wastes. Very low concentrations are fatal to fish. Cyanides are not natural components of surface waters.

ACIDITY:

Mineral acidity is present in many industrial wastes, particularly those from the metallurgical industry, or in leachate from refuse disposal sites. Acidity due to carbon dioxide is a normal component of all natural waters.

Acidity is of little concern from a sanitary or public health viewpoint. Carbon dioxide is not known to have any deleterious effects. Waters that contain mineral acidity are usually so unpalatable that problems related to human consumption are non-existent.

C. WATER SUPPLIES

The chemical analyses performed on water used as a source of supply for domestic and industrial purposes include: hardness, alkalinity, chlorides, iron, fluoride, pH, turbidity and colour.

HARDNESS:

No specific limit is usually placed on hardness although it is usually recommended that waters for domestic use should

contain less than 250 ppm hardness as $CaCO_3$. This recommended limit has been used to avoid excessive soap consumption and other problems, primarily economic, usually associated with hard water. The degrees of hardness are indicated as:

Soft	-	0-75 ppm as $CaCO_3$
Moderately hard	-	75-150 ppm as $CaCO_3$
Hard	-	150-300 ppm as $CaCO_3$
Very hard	-	greater than 300 ppm as $CaCO_3$

ALKALINITY:

Alkalinity of natural waters is due to the presence of salts of weak acids, usually bicarbonates. The concentration is reported in ppm as $CaCO_3$ and is significant in determining aggressive tendencies and softening treatment requirements.

CHLORIDES:

Chlorides are naturally present, in varying concentrations, in water supplies. Increasing chlorides concentration may indicate contamination from domestic sewage.

The recommended maximum concentration to avoid saline tastes is 250 ppm.

IRON:

The recommended maximum limit for iron in water supplies is 0.3 ppm. It is noted that waters with concentrations of iron in excess of 0.3 ppm are not harmful to consumers but have objectionable staining and sediment-forming properties, and may cause the deposition of iron in pipes or the growth of iron bacteria. If the concentration exceeds 1 ppm, problems with metallic taste may occur.

FLUORIDE:

Fluoride may occur naturally in water or it may be artificially applied at the supply and/or treatment works.

A fluoride concentration of approximately 1 ppm is considered beneficial in the prevention of dental caries. The recommended maximum and minimum limits of fluoride are 1.2 ppm and 0.8 ppm respectively.

TURBIDITY:

The significance of turbidity is included in Section B.

The turbidity of treated water should not exceed 5 Turbidity Units.

COLOUR:

The colour intensity of water is reported in Apparent Colour Units.

The colouration of natural water may result from contact with organic matter or chemical substances.

The recommended maximum colour content is 15 units.

FREE AMMONIA:

Free ammonia represents the first product of decomposition of organic matter, and thus appreciable concentrations of free ammonia usually indicate "fresh pollution" of sanitary significance.

Low	-	0.015 to 0.03 ppm
Moderate	-	0.03 to 0.10 ppm
High	-	0.10 or higher ppm

TOTAL DISSOLVED SOLIDS:

The effect of total dissolved solids influences taste and the laxative properties of a water supply. A limit of 500 ppm is used.

NITRATE:

Nitrate levels are specified as excessive concentrations may cause methemoglobinemia in infants. A limit of 45 ppm nitrate is specified as the upper limit.

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